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A Cyclopaedia of Knowledge and General Information

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VOLUME II.

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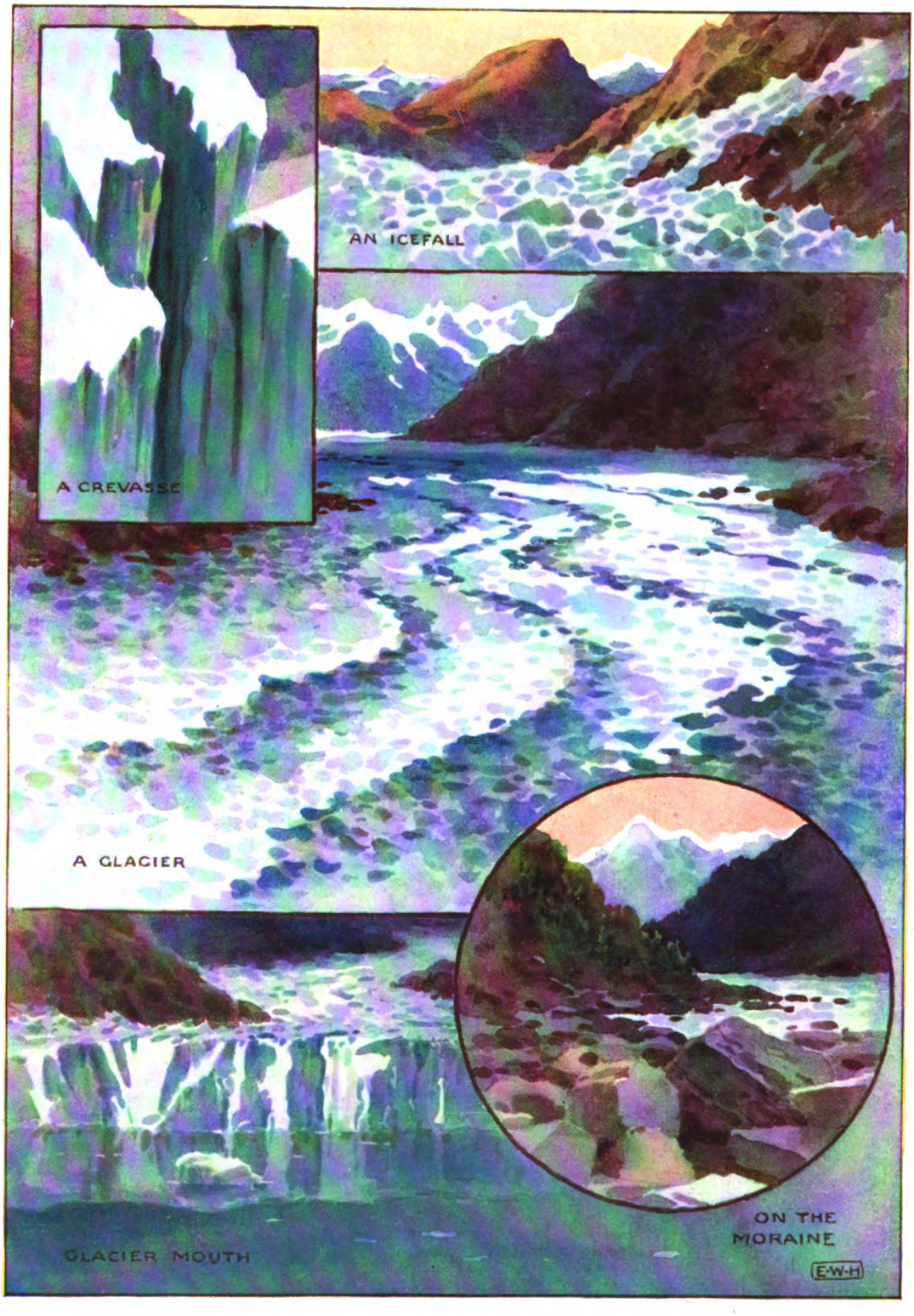

Along the edges of a glacier will be found a more or less definite line of fragments broken from the rocks on either side. These are called *moraines*. This moraine-stuff may fall down a *crevasse* in the ice formed when the glacier passes over uneven ground, and will be found all along the under surface of the glacier. (*See Vol. I., page* 492.)

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Continued from Vol. I., page 454.

ENGLISH LANGUAGE AND LITERATURE:

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SHAKESPEARE'S LIFE AND POEMS

WILLIAM SHAKESPEARE was born at Stratford-on-Avon, in 1564, probably on April 23rd. There is a record of his baptism on April 26th of that year. He died at Stratford on April 23rd, 1616, aged exactly fifty-two.

At Stratford-on-Avon

On the side of his mother, Mary Arden, the poet was of gentle birth. His father, John Shakespeare, was an energetic man, with too many irons in the fire, and cursed by a liking for going to law. Early in life he prospered and attained considerable local consequence. He was chosen alderman of Stratford, and, later, high bailiff of the town. His business was that of a dealer in agricultural produce—meat, corn, malt, wool, and hides. But, by the time William Shakespeare was in his 'teens, his father's prosperity had waned. Shakespeare, senior, fell into debt, mortgaged his wife's property, lost his public positions, and grew seriously needy before the fortunes of the family were retrieved by his son.

William was educated at the Free Grammar School in Stratford, but left at an early age, when his father became poor, and probably helped in the business.

Apparently, at this stage, he only succeeded in adding to the troubles of the household, for while he was still in his 'teens he married Ann Hathaway, an illiterate woman, considerably older than himself; and before he was twenty-one he had a family of three children. According to tradition, supported by indirect evidence, he became involved, through trespass, and perhaps poaching, in a feud with Sir Thomas Lucy, to whom, in later years, he paid off old scores by picturing him as Mr. Justice Shallow.

It is not clear when he left the town for London. Probably it was in 1585, when the fortunes of his family were at their lowest ebb, and John Shakespeare had been deprived of his aldermanic gown.

Early Triumphs

The five or six years which follow the removal to London can only be filled in by imagination. After that lapse of time we begin to hear of William Shakespeare as one who was winning a distinctive position in the world. In 1592, Robert Greene, the story-writer and dramatist, published a bitter attack on an actor who was becoming a playwright, and who thought himself "the only 'Shakescene' in the country." The attack was clearly directed against Shakespeare, and included a sneering quotation from his *Henry VI.*, Part I.

Shakespeare's first venture as a poet—*Venus and Adonis*—had now (1593) been

published, and next year came his *Lucrece*. In 1594 the poet is specially mentioned as a player in the leading theatrical company of the day, appearing by royal command before Queen Elizabeth.

So the Warwickshire youth, who, when he was twenty-two, had left home in poverty, and possibly in disgrace, had made his mark in London when he was thirty, first as an actor, next as a poet dallying with classical themes according to the fashion of the times, but among his closest associates was becoming best known, probably, as a reviser and author of plays.

How he had been led to the theatre as a means of livelihood and an avenue to fame we do not know. But during the time when his father was high bailiff of Stratford two of the leading companies of players had visited the town, and acted by leave of the municipal authorities. Then, too, the sumptuous revels by Elizabeth at Kenilworth were held when the poet was a lad living within walking distance. That part of England had long been a modest theatrical centre, as witness the cycle of Coventry plays. There must have been considerable opportunity for the cultivation of a taste for the stage, towards which the poet's genius would impel him, as a natural outlet for the romance that had coloured his thoughts from early boyhood.

From the portrait in the National Gallery: Photo. by Emery Walker

BEN JONSON,

Poet and Dramatist, Shakespeare's best friend and rival.

The rest of the poet's life, apart from his writings, is quickly told. In 1597, or about eleven years after he had left Stratford, Shakespeare returned sufficiently wealthy to re-establish the financial credit of the family and to buy the best house in the town. Three years later a "grant of arms" was made to his father, who thus more than resumed his social status. In 1599, at the age of 35, the poet became a prominent shareholder in the new Globe Theatre, and this property, with his salary as an actor, and his fees for the original plays, that were now being produced in quantity as astonishing as their quality, gave him a handsome income.

In 1611, or thereabouts, he retired from his profession as an actor to live the life of a country gentleman with literary relaxations. For some years he continued writing, and then, apparently, enjoyed a period of rest before his somewhat sudden death at the age of fifty-two.

He was buried in the chancel of Stratford-on-Avon Church, and he wrote for his grave a warning inscription of a kind that would be understood by casual but superstitious grave-diggers :

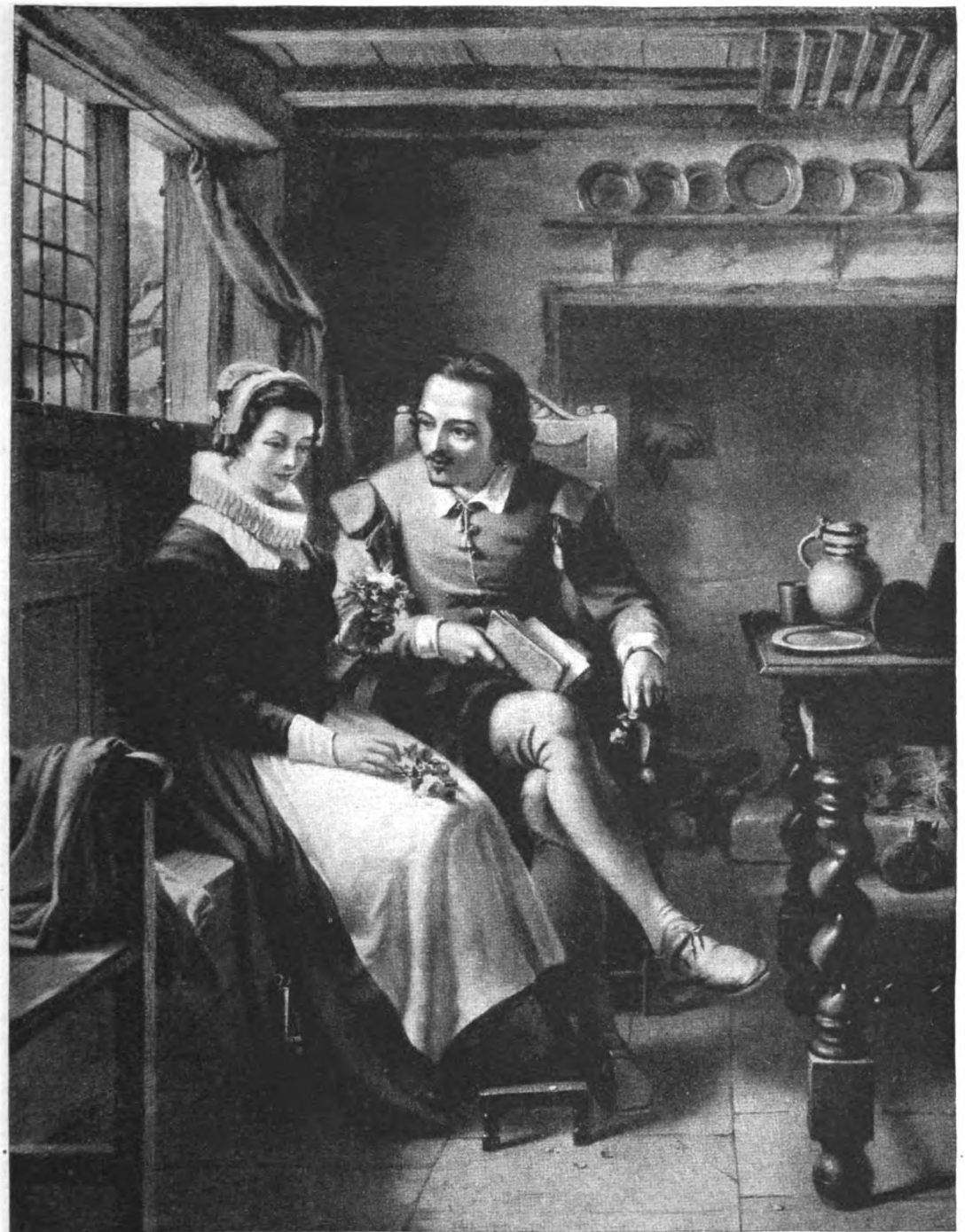
> Good friend, for Jesus' sake forbeare
> To dig the dust enclosed heare ;
> Bleste be the man that spares these stones,
> And curst be he that moves my bones.

And because of this tomb, in this most English of churches, all the world journeys there on pilgrimage.

Though we know so little of Shakespeare's life, except what may be inferred from his books, a general impression of the man has come down to us from his contemporaries. It represents him as alert and bright in conversation, courteous and gentle in manner, a joyous friend, beloved as well as admired, copious in the outflow of his amazing mind, and throwing off his writings with a careless ease. All that we hear of him from such sources as his friend and rival, Ben Jonson, tells us that Shakespeare was such a man as his books would lead us to expect him to be—a large-minded man of the world, tolerant to the extent of generosity, with an experience of mankind rare in its width. Obviously, too, he passed through profound emotional crises that enabled him to tinge all kinds of characters with his own experience.

In judging Shakespeare's plays it must always be remembered that they were written primarily to be acted under the conditions prevailing in the theatres of his day. They were not written for the library. At first they adapted popular themes to popular taste—as in the historical plays. Later, Shakespeare seemed to choose subjects that suited his own mood and harmonised with the stage of life to which he had arrived ; but in dealing with these themes, that seem to be almost a personal reflection, he always had stage requirements in view.

His *business* was that of a playwright. Incidentally he was a poet, wielding unexampled power ; a perfect master of the most exquisite literary skill ; a philosopher whose insight puts studious science to the



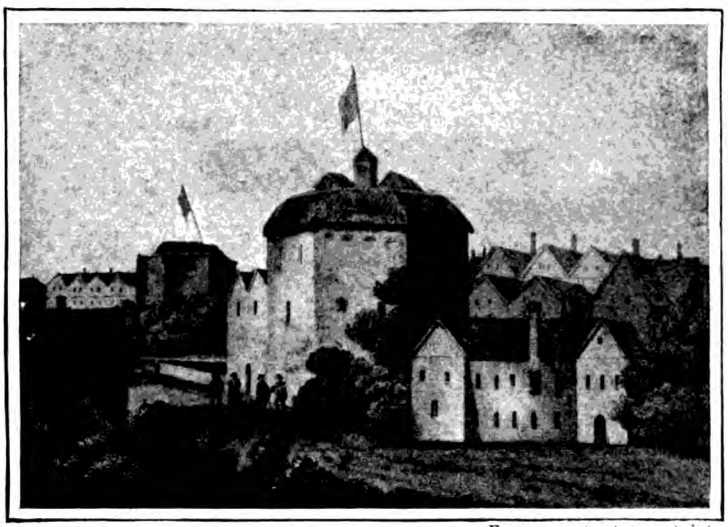
From the picture by Thomas Brooks. By permission of Henry Graves & Co., Ltd.

SHAKESPEARE'S COURTSHIP.

While still in his 'teens, Shakespeare wooed and wed an illiterate woman considerably older than himself, one Ann Hathaway, by whom he had three children before he was twenty-one.

blush; a humorist who accepted human nature without any exclusions. It must never be forgotten, however, that these qualities were sunk, for the most part, in the dramatist who was not providing the world, consciously, with immortal literature, but was writing something which his company of actors could play with a ring of reality, or with mental charm. When we realise that the man who more than all others wrote "not for an age, but for all time," achieved his unparalleled feat by the way, so to speak, and glamour there is in these and all other songs of the poet!

Of the poems, *Venus and Adonis* is essentially an exercise in workmanship. It shows that the countryman turned poet could chisel and polish a poem after the fashion of Ovid with the best of the University wits. In *Lucrece* there was an approach to the diapason note of later years. Such passages as that on Time's ravages must have convinced readers that a poet of unexampled power was finding his natural expression.



From a contemporary print.

THE GLOBE THEATRE IN 1612.

A patent to perform plays here was granted to William Shakespeare and others by James I., in 1603. In 1612 the thatch of the theatre caught fire and the building was burned to the ground.

Time's glory is to calm contending Kings,
To unmask falsehood and bring truth to light,
To stamp the seal of Time in aged things,
To wake the morn and sentinel the night,
To wrong the wronger till he render right,
To ruinate proud buildings with thy hours,
And smear with dust their glittering golden towers.

To fill with worm-holes stately monuments,
To feed oblivion with decay of things,
To blot old books and alter their contents,
To pluck the quills from ancient ravens' wings,
To dry the old oak's sap and cherish springs,
To spoil antiquities of hammer'd steel,
And turn the giddy round of Fortune's wheel.

To shew the beldame daughters of her daughter,
To make the child a man, the man a child,
To slay the tiger that doth live by slaughter,
To tame the unicorn and Lion wild,
To mock the subtle in themselves beguiled,
To cheer the ploughman with increaseful crops,
And waste huge stones with little water-drops.

without conscious effort, as a part of his daily round, we shall appreciate more deeply the all-embracing greatness which he "took in his stride."

Shakespeare's experiments in pure poetry are found in his *Venus and Adonis*, *Lucrece*, *Sonnets*, and the songs interspersed through his plays. The Elizabethan age resounds with songs—graceful, fanciful, melodious, self-singing. No reminder of this lyric charm has been heard since, except perhaps in a few graver singing-melodies by Tennyson. The art of song writing seemed to be in the Elizabethan air. But one note rose clearly into the "pure serene" to lead the lovely chorus. It was the note of Shakespeare.

"Tell me where is fancy bred?" "Who is Sylvia? What is she?" "Full fathom five thy father lies"; "O mistress mine, where are you roaming?" "Blow, blow, thou winter wind!" "Fear no more the heat o' th' sun"—what a wealth of music

Whatever style of writing Shakespeare attempted, he passed straight into the select band of the unexcelled. It was so with his sonnets. Only Milton and Wordsworth at their best can be named with him as writers of sonnets that haunt for ever the minds of receptive readers.

The *Sonnets* were not printed together till 1609, and then Shakespeare does not seem to have assented to their publication. But two of them had been pirated ten years earlier, and in 1598 Francis Meres, to whom posterity is indebted for the first list of

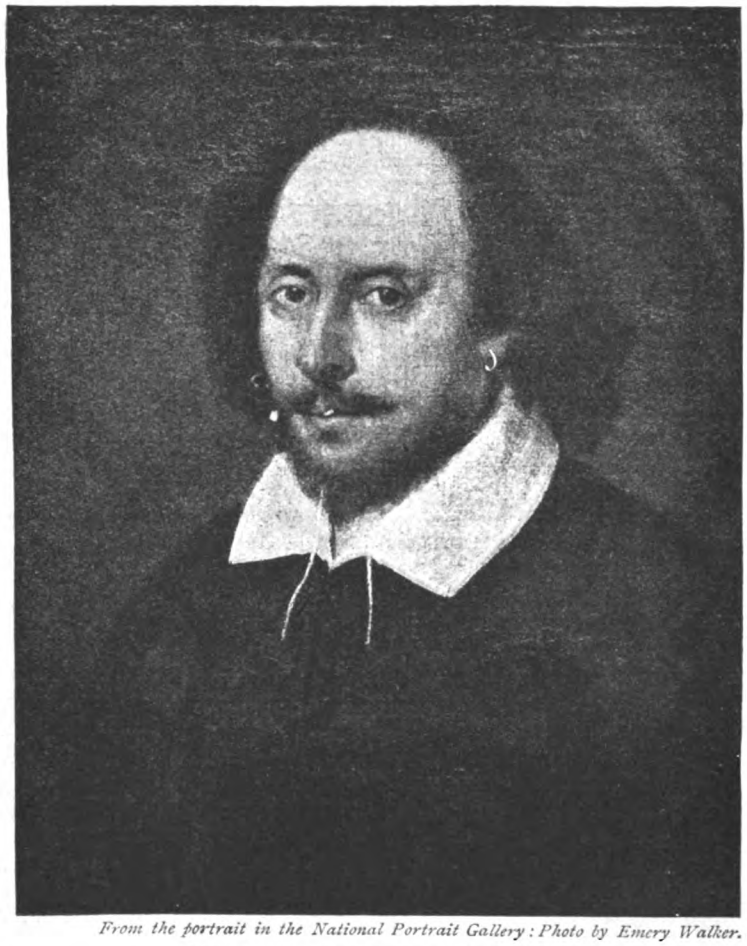
plays then known to be Shakespeare's, mentioned the circulation among friends of the poet's "sugared sonnets" in manuscript form.

Many books have been written to explain the inner history of the sonnets, and identify the handsome wanton youth and the dark false woman addressed in them, but the general effect of controversial speculation is to draw the reader away from an obvious and spontaneous enjoyment of this fine series of poems. The fact is that the writing of sonnets in Shakespeare's day was such a popular and artificial exercise, that it is often impossible to distinguish when a writer was adopting a pose and when he was sincerely disclosing a personal experience. Enjoyment of these sonnets does not depend in any degree on the reader's knowledge of the tangle of personal passions which inquiry has failed to unravel.

Apart from those passions, the most recurrent idea, which keeps up a solemn reverberation through the sonnets, is our natural revulsion against the obliterating effects of Time.

Like as the waves make towards the pebbled shore,
So do our minutes hasten to their end;
Each changing place with that which goes before,
In sequent toil all forwards do contend.
Nativity, once in the main of light,
Crawls to maturity, wherewith being crowned,
Crooked eclipses 'gainst his glory fight,
And Time that gave doth now his gift confound.
Time doth transfix the flourish set on youth
And delves the parallels in beauty's brow,
Feeds on the rarities of nature's truth,
And nothing stands but for his scythe to mow.
And yet at times in hope my verse shall stand,
Praising thy worth, despite his cruel hand.

Let me not to the marriage of true minds
Admit impediments. Love is not love
Which alters when it alteration finds,
Or bends with the remover to remove:
O, no! it is an ever-fixéd mark,
That looks on tempests and is never shaken;
It is the star to every wandering bark,
Whose worth's unknown, although his height be taken.
Love's not Time's fool, though rosy lips and cheeks
Within his bending sickle's compass come;
Love alters not with his brief hours or weeks,



From the portrait in the National Portrait Gallery: Photo by Emery Walker.

WILLIAM SHAKESPEARE (1564-1616).

The Chandos Shakespeare reproduced here is probably the most generally accepted portrait of our greatest dramatist, though, as a matter of fact, its authenticity is more than doubtful.

But bears it out even to the edge of doom.
If this be error and upon me proved,
I never writ, nor no man ever loved.

In the age of poetic sweetness it was the unapproached clarity of the Shakespearean sweetness that first charmed his contemporaries; although, in the year 1600, Francis Meres had already hailed him first in tragedy and first in comedy. To those phases of his work we must next turn. J. D.

THE ENGLISH LANGUAGE.—VI

ADVERBIAL clauses, modifying verbs, form a common variety of subordinate clauses, and express the various relationships of adverbs, as in the following examples :

I came *when I could.*—Adverbial Clause of Time.
I came *where I could see you.*—Adverbial Clause of Place.
I walked *as a man ought to walk.*—Adverbial Clause of Manner.
He was so tired *that he could not walk.*—Adverbial Clause of Extent.
He came, *because I asked him.*—Adverbial Clause of Cause.
He came, *although I did not ask him.*—Adverbial Clause of Concession.
He would come, *if you wish it.*—Adverbial Clause of Condition.
He came *that he might see me.*—Adverbial Clause of Purpose.

All these adverbial clauses modify the verb in the principal clause.

Prepositions and Conjunctions

A preposition is a word which shows the relation between one word and another which precedes it ; e.g. the pen *in* my hand ; tired *of* waiting ; I ran *over* the course. All prepositions in English govern nouns or pronouns in the objective case.

Most prepositions were originally adverbs, and can be used as such ; e.g. I came *in ;* the man fell *over.*

No better test of a man's observant and accurate knowledge of English idiom can be found than in his use of the appropriate preposition after particular words ; but the subject is much too wide and detailed to be treated here. To confer *on* is not the same as to confer *with ;* to differ *from* is not the same as to have a difference *with.* I should disagree *with* a person and be adverse *to* him, insensitive *to* his faults and unconscious *of* his virtues. And so on, the student being recommended to keep his eyes open while reading.

Compound prepositions are becoming ever more numerous and more hackneyed, and they are one of the distinguishing marks of the hasty and slipshod writer. There is no objection to *in spite of* or *on account of* or *in order to ;* but *as far as, in so far as, inasmuch as, with respect to, as to,* and many other similar phrases are over-used, and care should always be taken that they carry their proper force whenever they are used. In "I was careless as to what happened," we have an instance of the slovenly use of *as to ;* in the useless and ridiculous locution *as to whether, as to* is utterly unnecessary—e.g. "I was careless [as to] whether you came or not."

The conjunction is a joining word, linking words or sentences together. There are two main kinds : the co-ordinating and the subordinating.

Sentences (words and phrases, too) are said to be co-ordinate when they are performing the same grammatical function and are not dependent on one another ; e.g. "I came in and he went home." Here two simple sentences are simply linked together without grammatical interrelation ; the conjunction *and* makes no modification of the meaning. Nevertheless we may regard the combined statements as a unity, and speak of the whole as a compound or multiple sentence. Observe that in a compound sentence the component sentences are co-ordinate, whereas in a complex sentence one or more of the constituent clauses are subordinate.

The various types of co-ordinating conjunction are indicated in the following list :

Additive	-	*and, also, both . . . and.*
Adversative	-	*but, however, yet, nevertheless.*
Illative	-	*therefore, then, so, consequently.*
Alternative	-	*either . . . or, neither . . . nor, else.*

The Use of *However*

Concerning the use of these words a few points may be mentioned. Note that *also* and *however* should not be used at the commencement of a sentence ; such a construction as "This book is mine, also that" should be avoided. *And* should not in general be repeated in a string of words or sentences : it should join only the last two. The tendency to its undue repetition has to be constantly watched. *Both . . . and, either . . . or, neither . . . nor,* form pairs of correlative conjunctions ; and in using them we must take care that they correlate equivalent words, phrases or sentences ; e.g. the following examples show bad correlation :

(i) He was both extremely hungry and had to rest.

(ii) You will either give me what I ask, or I shall compel you.

(iii) John could neither go, nor could William.

These are examples of the general rule about co-ordination, viz. that co-ordination should occur only between like and like, and as far as possible equally. A single word co-ordinated with a sentence is clumsy, even when it is allowable, as in the co-ordination

between an adverb and an adverb clause in (iv) :

(iv) He ran to me quickly and when I called him.

The mistakes in (i)—(iii) above are of course worse than this : they infringe upon the rule of likeness and upon the rule of equality. For instance, in (iii) we desire to co-ordinate John with William, but we have in fact co-ordinated *go* with *could William.*

Subordinate Conjunctions

Most of the subordinate conjunctions introduce adverbial clauses, and the various types have been already indicated. We add a few remarks on some particular examples.

When, where, whence, whither, why, how, are sometimes known as conjunctive adverbs, because, while they act as subordinating conjunctions, they also modify the verb in the sentence which they introduce. Some of these words may also be *relative adverbs,* as in "This is the house where I found you." Here *where = in which,* and the clause *where I found you* is the adjunct of *house ;* it is therefore an adjectival and not an adverbial clause. The student should master this distinction very carefully.

That, when it is a conjunction, may introduce an adverbial clause of purpose ; but more commonly it introduces what is known as a noun clause ; e.g. "I said that I was coming." Clearly the clause *that I was coming* acts as the object of the transitive verb *said,* and is thus the equivalent of a noun. A noun clause may also be the subject of the verb in the principal clause ; e.g. "That I am coming is true," or "It is true that I am coming" ; in the latter case *it* is the grammatical subject of the verb *is,* but the noun clause is in apposition with it.

As is a useful little word, which sometimes presents grammatical difficulty. It may be a relative pronoun, corresponding to an antecedent *such* or *the same.* It may be an adverb of degree or of manner ; e.g.—

He is *as* clever as his brother. [Degree.]

Finally, it may be a subordinating conjunction : the second *as* in the above example introduces the adverbial clause *his brother* (*is*), and is therefore a conjunction. The familiar use of *as* frequently allows the omission of the verb in the subordinate clause. This gives *as* the appearance of a preposition, but the missing verb can always be supplied ; e.g.—

Speaking as a friend [would speak], I advise you not to go.

On no account must *like* be used as an alternative for *as ; like* is an adjective and never a conjunction ; the error in "I did that like you did" is at once common and unpardonable. In "I did that like him," *like* is an adjective qualifying *I* and governing *him* in the dative case.

So, when a conjunction, is the equivalent of *therefore.* More commonly it is an adverb of manner or degree ; it is used as the equivalent of *as* only in negative sentences ; e.g. "He is not *so* clever as his brother" : we cannot say, "He is so clever as his brother."

The distinction between the adverb, the preposition, and the conjunction can be well seen in the uses of a word like *before ;* e.g.—

(i) He went *before.* [Adverb, modifying *went.*]
(ii) He went *before* me. [Preposition, governing *me.*]
(iii) He went *before* I did. [Conjunction, joining two sentences.]

Similarly the examination of the following uses of *but* is instructive :

(i) There was no one *but* disagreed with you. [Relative pronoun = who not.]
(ii) There were *but* few men present. [Adverb = only.]
(iii) There was no one there *but* me. [Preposition = except.]
(iv) I came, *but* he did not. [Conjunction.]

Note the error in (v) :—

(v) There was no one there but you and *I* [me].

Analysis of Sentences

Analysis is the process by which a sentence is split up into its component parts, and the relation of these parts to one another displayed ; its object is to make a thorough grammatical examination of the structure of the sentence ; and the power to carry it out correctly is the best test of a complete understanding of sentence-architecture that the student can make. The process should be done in two steps : (1) general, (2) detailed.

As an example, we will analyse the following sentence : "The man entered the room, and, when he had taken off his hat, he informed us that he had travelled many miles for the purpose of seeing a friend who lived in the town."

Preliminary Analysis

The sentence is compound (double), consisting of :

A. Simple Sentence - The man entered the room.
B. Complex Sentence - and, when he had . . . the town.

General Analysis

A. The man entered the room	Simple Sentence.
B 1. He informed us.	Principal Clause.
B 2. When he had taken off his hat.	Adverbial Clause, mod. *informed* in B 1.
B 3. That he had travelled many miles for the purpose of seeing a friend.	Noun Clause, gov. by *of*, understood after *informed*.
B 4. Who lived in the town.	Adjective Clause, qual. *friend* in B 3.

Detailed Analysis

A. SUBJECT proper—man.
Enlargement—the.
PREDICATE Verb—entered.
Extension of Verb—the room (*place*).

B 1. CONNECTING WORD—and.
SUBJECT proper—he.
PREDICATE Verb—informed.
Object—us.
Indirect Object—Clause B 3.
Extension of Verb—Clause B 2.

B 2. SUBJECT Proper—he.
PREDICATE Verb—had taken.
Object—hat.
Enlargement—his.
Extension of Verb—off (*place*); when (*time*).

B 3. CONNECTING WORD—that.
SUBJECT Proper—he.
PREDICATE Verb—had travelled.
Extension of Verb—many miles (*degree*); for the purpose of seeing a friend (*cause*).

B 4. SUBJECT Proper—who.
PREDICATE Verb—lived.
Extension of Verb—in the town.

Many sentences in common use are elliptical, and in analysis the words that are omitted must be supplied; e.g.—

(i) Go to bed = You go to bed.
(ii) I came and saw you = I came and I saw you.
(iii) He is quicker than I = He is quicker than I am

But this need not be done in the case of truly multiple subjects, predicates, or objects; e.g. "You and I were going to London." Here *you and I* form a double subject of the verb *were going*, and the sentence is not elliptical at all.

Parsing

Parsing applies to individual words the same process as analysis applies to sentences; its object is to give a complete grammatical description of each word, ending with its syntax, or relation with other words in the sentence. As a model we will parse each word in the following sentence: "Many men who lived in London have been seen returning from active service."

Many—Adj. quantity; positive degree; qual. *men*.
men—Noun, common, 3rd, plural, masculine, nominative, subj. of *have been seen*.
who—Pronoun, relative, 3rd, plural, masculine (agreeing with antecedent *men*), nominative, subject of *lived*.
lived—Verb, intrans., weak, active, indicative, past, 3rd, plural, agreeing with *who*.
in—Preposition, gov. *London*.
London—Noun, proper, 3rd, singular, neuter, objective, gov. by *in*.
have been seen—Verb, trans., strong, passive, indicative, present perfect, 3rd, plural, agreeing with *men*.
returning—Verb, intrans., weak, active, participle, present, qual. *men*.
from—Preposition, gov. *service*.
active—Adjective, quality; positive degree; qual. *service*.
service—Noun, abstract, 3rd, singular, neuter, objective, gov. by *from*.

Exercises

1. Analyse the following sentences:

(*a*) If a student wishes to make progress, he must work hard.

(*b*) The gentleman with whom I was conversing remarked that he had just left a house that was on fire.

(*c*) It is not wise to crow before you are out of the wood.

(*d*) Do you know how many persons entered the building while I was there?

(*e*) That the Government should resign is the most absurd suggestion that I have heard made since the crisis began.

(*f*) Can I forget where I found the kindest hospitality when I was in need?

(*g*) It is such men as Mr. X that have made our reputation so discreditable.

(*h*) They have sent as many men as they could spare.

2. What is meant by anomalous verbs? Discuss the various uses of *may, will, shall, should, durst*.

3. Parse each word in: Good music sounds sweetest by night, when all is still.

4. Comment on the syntax of the following:

(*a*) I would not go if I was in your place.

(*b*) He will be allowed to go if he dares.

(*c*) He came to see me, just like his friend did.

(*d*) He is not as rich as me.

(*e*) I met John in the park yesterday, also Charlie in the town.

(*f*) I went into the potato shop and bought some of them.

5. Write sentences showing that you can use the correct preposition after each of the following words: *Different, indifferent, adverse, averse, disagree, agreeable, derogate, derogatory, contemporary, patient, oblivious, consist, consent, endow, acquiesce, abstain.*

E. W. E.

Continued from Vol. I., page 460.

HISTORY:

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BRITAIN'S STORY.—III

[*The introductory chapter of* LORD MACAULAY'S "*History of England*" *has been adopted in this work to explain the development of the British race prior to* 1660. *But as Lord Macaulay's work was intended merely as a sketch, explanatory passages (printed in closer type) have been interpolated in order to meet the requirements of the student.*]

DURING the century and a half which followed the Conquest, there is, to speak strictly, no English history. The French Kings of England rose, indeed, to an eminence which was the wonder and dread of all neighbouring nations. They conquered Ireland. They received the homage of Scotland. By their valour, by their policy, by their fortunate matrimonial alliances, they became far more powerful on the Continent than their liege lords the Kings of France.

Richard Cœur-de-Lion

Asia, as well as Europe, was dazzled by the power and glory of our tyrants. Arabian chroniclers recorded with unwilling admiration the fall of Acre, the defence of Joppa, and the victorious march to Ascalon; and Arabian mothers long awed their infants to silence with the name of the lion-hearted Plantagenet [Richard Cœur-de-Lion]. At one time it seemed that the line of Hugh Capet was about to end as the Merovingian and Carlovingian lines had ended, and that a single great monarchy would spread from the Orkneys to the Pyrenees.

So strong an association is established in most minds between the greatness of a sovereign and the greatness of the nation which he rules, that almost every historian of England has expatiated with a sentiment of exultation on the power and splendour of her foreign masters, and has lamented the decay of that power and splendour as a calamity to our country. This is, in truth, as absurd as it would be in a Haytian negro of our time to dwell with national pride on the greatness of Lewis the Fourteenth, and to speak of Blenheim and Ramilies with patriotic regret and shame.

The Conqueror and his descendants to the fourth generation were not Englishmen: most of them were born in France: they spent the greater part of their lives in France: their ordinary speech was French: almost every high office in their gift was filled by a Frenchman: every acquisition which they made on the Continent estranged them more and more from the population of our island.

King John's Misrule

One of the ablest among them indeed [Henry I.] attempted to win the hearts of his English subjects by espousing an English princess. But, by many of his barons, this marriage was regarded as a marriage between a white planter and a quadroon girl would now be regarded in Virginia. In history he is known by the honourable surname of Beauclerc; but, in his own time, his own countrymen called him by a Saxon nickname, in contemptuous allusion to his Saxon connection.

Had the Plantagenets, as at one time seemed likely, succeeded in uniting all France under their government, it is probable that England would never have had an independent existence. Her princes, her lords, her prelates, would have been men differing in race and language from the artisans and the tillers of the earth. The revenues of her great proprietors would have been spent in festivities and diversions on the banks of the Seine. The noble language of Milton and Burke would have remained a rustic dialect, without a literature, a fixed grammar, or a fixed orthography and would have been contemptuously abandoned to the use of boors. No man of English extraction would have risen to eminence, except by becoming in speech and habits a Frenchman.

England owes her escape from such

calamities to an event which her historians have generally represented as disastrous. Her interest was so directly opposed to the interest of her rulers that she had no hope but in their errors and misfortunes.

The talents and even the virtues of her first six French Kings were a curse to her. The follies and vices of the seventh were her salvation. Had John inherited the great qualities of his father, of Henry Beauclerc, or of the Conqueror, nay, had he even possessed the martial courage of Stephen or of Richard, and had the King of France at the same time been as incapable as all the other successors of Hugh Capet had been, the House of Plantagenet must have risen to unrivalled ascendency in Europe.

Magna Carta

But, just at this conjuncture, France, for the first time since the death of Charlemagne, was governed by a prince of great firmness and ability. On the other hand, England, which since the battle of Hastings had been ruled generally by wise statesmen, always by brave soldiers, fell under the dominion of a trifler and a coward.

From that moment her prospects brightened. John was driven from Normandy. The Norman nobles were compelled to make their election between the island and the continent. Shut up by the sea with the people whom they had hitherto oppressed and despised, they gradually came to regard England as their country, and the English as their countrymen.

The two races, so long hostile, soon found that they had common interests and common enemies. Both were alike aggrieved by the tyranny of a bad king. Both were alike indignant at the favour shown by the court to the natives of Poitou and Aquitaine. The great-grandsons of those who had fought under William and the great-grandsons of those who had fought under Harold began to draw near to each other in friendship; and the first pledge of their reconciliation was the Great Charter, won by their united exertions, and framed for their common benefit.

When the Conqueror obtained possession of England in 1066 he gave the land to be divided among his followers as a reward for their services. The only condition he imposed upon them—a very necessary one to a prince who was only in military possession of the country—was that, whenever summoned, they should attend him with so many men-at-arms, etc., according to the extent of their fees, or holdings, for six weeks at their own expense.

This was the only strictly feudal obligation; but custom added a number of other obligations. If a baron died, his heir had to pay a sum of money by way of "relief," as it was called, or a fee to induce the King to accept him in his father's stead; and if the heir were under age, the King had the wardship of him, an office which enabled the King to put into his own treasury the difference between the youth's income and the cost of his keep and education, for though the situation was really one of trust, it was commonly made the means of profit. If the ward were a woman, her guardian could marry her to whom he pleased.

For the purpose of making the King's eldest son a knight, and for providing a dower for his eldest daughter, custom required that all the King's tenants should subscribe; and when the King went on a journey through any part of the country, his purveyors were in the habit of taking for the royal use cattle, provisions, horses, carts, and whatever else might be wanted.

Though as a matter of prudence the feudal prince summoned the council of all his tenants if he wanted their advice, he was under no legal obligation to summon them; and they might not meet unless he did so. While it was not supposed that a feudal prince could want money, seeing that he had large demesne lands specially reserved for him, there was no law forbidding him either to ask for or to take it from the tenants.

Now it is easy to see that these institutions were liable to great abuse—and they were abused to an unbearable extent. Reliefs, wardship, purveyance, the expensive military attendance, or the money commutation of it—all were the means of screwing money or money's worth out of the people; and the Church, which held a great proportion of the land in the kingdom, was subject to spoliation as well as the lay tenants.

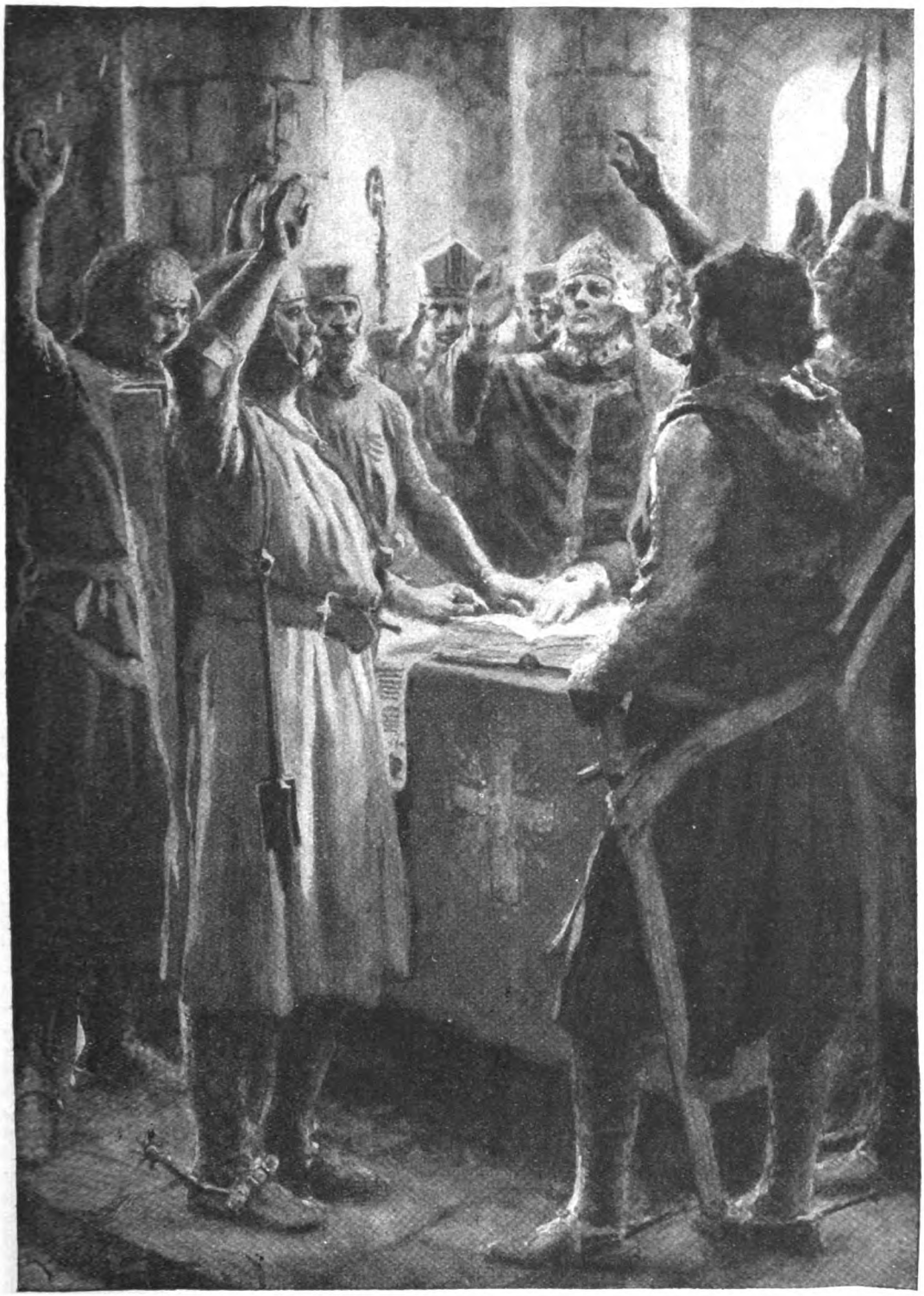
Forest Laws

The sacred trust of guarding the infant orphan was sold for a fixed sum, and the purchaser of the trust got all he could for his money out of the ward's estate; men bought the right to marry heiresses who were wards of the King, and the rights were sold to the highest bidder, almost without reference to personal gratification.

But this was not all. King John gave that worst sign of an evil government—the sale of justice. Henry II. had sold decrees, but the abuse culminated under John. Numerous entries were made on the roll of the Exchequer—sometimes of money, sometimes of goods—in consideration of the King's influence to get a verdict. The judges also took bribes—and that in cases where the Crown was concerned.

Lastly, there was the great grievance of the forest laws—remote ancestors of our existing game laws. These laws, framed by the Conqueror, who, according to a Norman monk, "loved the tall stags as if he had been their father," made it a felony, punishable with loss of limb, for an unauthorised person to be found in a forest, and by the same law it was made a capital offence to kill a stag.

If the King acted in this way towards the barons, prelates, and other chief tenants, one can imagine perhaps how the latter acted towards those under them. Still, they made the best recompense they



THE GREAT "STRIKE" FOR LIBERTY.

At a formal meeting in London, in August, 1213, the Barons of England, at the instigation of Archbishop Langton, took solemn oath to force King John, by their concerted action, to grant anew and enlarge the Charter of Henry I.

could by including them in the Charter of Liberties; though the labourers, the *villeins*, as they were called—the poor slaves who "knew not in the evening what they were to do in the morning, but were bound to do whatever they were commanded"—benefited but slightly from Magna Carta; their time of emancipation had not yet come.

With the passing of the Great Charter must be associated the name of Stephen Langton, an Englishman who had been promoted to the See of Canterbury by the Pope, in defiance and in spite of the King. Langton soon acquired much popularity in the country by his stubborn opposition to the tyrannies of John; and he it was who at a meeting of the barons in St. Paul's produced the Charter granted by Henry I., and suggested that steps should be taken to force King John to enlarge it and grant it anew.

This happened in August, 1213.

In November of the following year the barons met again at Bury St. Edmunds, Langton having in the meantime prepared a draft of the demand that should be made upon the King. The Archbishop read to the assembly the Charter he had drafted. The barons greeted his words with loud applause, "and at length," we are told, "it was agreed that after the Nativity of our Lord they should come to the King in a body to desire a confirmation of the liberties before mentioned; and that in the meantime they were to provide themselves with horses and arms in the like manner, that if the King should perchance break through that which he had specially sworn (which they well believed), and recoil by reason of his duplicity, they would instantly, by capturing his castles, compel him to give them satisfaction."

On January 6th, 1215, the barons waited on the King and presented their demands. John asked for time in which to consider the matter. He was given until Easter. The barons then met at Brackley; but, since the King's answer proved unsatisfactory, rose in arms, and marched on London, entering the capital on May 17th.

REMAINS OF THE GREAT CHARTER

which King John signed on 15th June, 1215, and which rests the liberties of British subjects.

John then began to treat, and finally agreed to attend an assembly on June 15th at Runnymead. There, in the presence of the archbishop, the whole of the baronage, and a vast assembly of other ranks, Magna Carta was duly signed and sealed. And never has a law been held in higher esteem. The later confirmations are almost beyond reckoning; fifteen are found in Edward III.'s reign alone; and on the very day that Charles II. entered London as a restored king, he was asked to ratify the Charter.

Magna Carta provided, first, "That the Church of England shall be free, and have her whole rights and liberties inviolable."

It then went on to fix exactly the nature and extent of the feudal obligations, not only of the barons towards the king, but also of the smaller holders towards the barons; the liberties of cities and towns were confirmed, the redress of existing grievances (such as the employment of foreign troops against Englishmen) assured; and the infliction of arbitrary, irresponsible punishments expressly abolished.

But the really important clauses of the Charter were those which provided that no tax should be levied but by order of the "General Council of our kingdom"; that the royal officers who acted illegally should be personally responsible; and lastly, that no freeman should be imprisoned *except by the legal judgment of his peers, or by the law of the land.*

Here commences the history of the English nation.

The history of the preceding events is the history of wrongs inflicted and sustained by various tribes, which indeed all dwelt on English ground, but which regarded each other with aversion such as has scarcely ever existed between communities separated by physical barriers. For even the mutual animosity of countries at war with each other is languid when compared with the

animosity of nations which, morally separated, are yet locally intermingled.

In no country has the enmity of race been carried farther than in England. In no country has that enmity been more completely effaced. The stages of the process by which the hostile elements were melted down into one homogeneous mass are not accurately known to us. But it is certain that, when John became King, the distinction between Saxons and Normans was strongly marked, and that before the end of the reign of his grandson it had almost disappeared.

In the time of Richard the First, the ordinary imprecation of a Norman gentleman was, "May I become an Englishman!" His ordinary form of indignant denial was, "Do you take me for an Englishman?" The descendant of such a gentleman a hundred years later was proud of the English name.

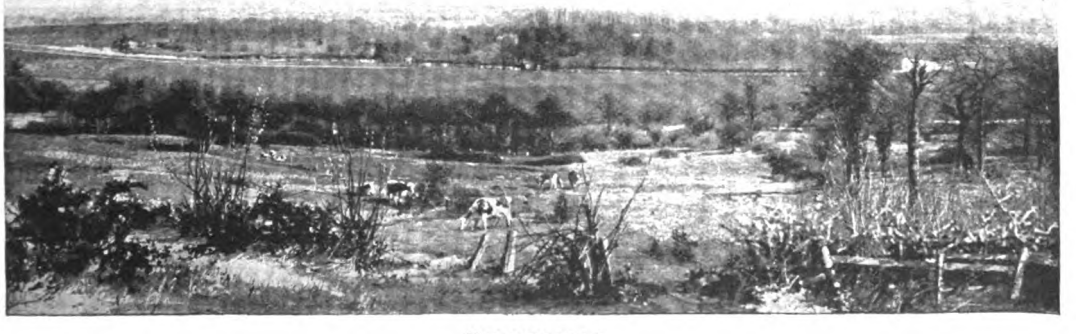
The sources of the noblest rivers which spread fertility over continents, and bear richly laden fleets to the sea, are to be sought in wild and barren mountain tracts, incorrectly laid down in maps, and rarely explored by travellers.

To such a tract the history of our country during the thirteenth century may not unaptly be compared. Sterile and obscure as is that portion of our annals, it is there that we must seek for the origin of our freedom, our prosperity, and our glory. Then it was that the great English people was formed, that the national character began to exhibit those peculiarities which it has ever since retained, and that our fathers became emphatically islanders, islanders not merely in geographical position, but in their politics, their feelings, and their manners.

Then first appeared with distinctness that constitution which has ever since, through all changes, preserved its identity; that constitution of which all the other free constitutions in the world are copies, and which, in spite of some defects, deserves to be regarded as the best under which any great society has ever yet existed during many ages. Then it was that the House of Commons, the archetype of all the representative assemblies which now meet, either in the old or in the new world, held its first sittings.

Then it was that the common law rose to the dignity of a science, and rapidly became a not unworthy rival of the imperial jurisprudence. Then it was that the courage of those sailors who manned the rude barks of the Cinque Ports first made the flag of England terrible on the seas. Then it was that the most ancient colleges which still exist at both the great national seats of learning were founded.

Then was formed that language, less musical indeed than the languages of the south, but in force, in richness, in aptitude for all the highest purposes of the poet, the philosopher, and the orator, inferior to the tongue of Greece alone. Then too appeared the first faint dawn of that noble literature, the most splendid and the most durable of the many glories of England.



RUNNYMEAD.

A modern view of the meadow, between Staines and Windsor, where on 15th June, 1215, King John met his barons and signed the Great Charter.

Continued from Vol. I., page 479.

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Contributors:—ANTHROPOLOGY AND ETHNOLOGY (Sir H. H. Johnston, G.C.M.G., K.C.B.). ASTRONOMY (Arthur R. Hinks, M.A., F.R.S.). BOTANY (E. W. Edmunds, M.A., B.Sc.[Lond.]). CHEMISTRY (E. H. Tripp, Ph.D.). ELECTRICITY AND MAGNETISM (L. M. Parsons, M.Sc., D.I.C., F.G.S.). GEOLOGY AND MINERALOGY (Arthur Holmes, D.Sc.[Lond.], A.R.C.S., D.I.C., F.G.S.). PHYSIOLOGY (Sir Malcolm Morris, K.C.V.O., and D. W. Carmalt-Jones, M.A., M.D.[Oxon.]). SOUND, LIGHT, AND HEAT (E. W. Edmunds, M.A., B.Sc.[Lond.]). ZOOLOGY (E. A. Bryant and Ashley G. Brown, F.Z.S.).

CHEMISTRY.—IX

Water of Crystallisation.—By the action of heat upon dry crystals it is found that some of them evolve water and that others do not. The former lose their crystalline shape when the water is expelled, but the latter remain crystalline. Such water is called "water of crystallisation." Copper sulphate, alum, borax, Glauber's salt and white vitriol contain this chemically combined water, but potassium chlorate, nitre, salt and lead nitrate are free from it.

When copper sulphate is heated it loses its water and becomes white and amorphous. It is then said to be "*anhydrous*," which means "without water"; when the water of crystallisation is present, the substance is said to be "*hydrated*." The white anhydrous copper sulphate forms an excellent test for water, because it at once goes green, then blue, and evolves heat, when placed in contact with it.

Experiment XXX.—*To find the percentage of water of crystallisation in copper sulphate.*

A small porcelain crucible, without the lid, is heated in a gas flame, cooled, and then weighed. About 0·5 gram of powdered copper sulphate is put into it and the combined weight carefully taken. It is then placed in a pipe-clay triangle on a tripod stand and very cautiously heated with a flame about 1–1½ in. high and slightly luminous at the top. It is very important that the sulphate should not be exposed to too high a temperature, because other substances besides water of crystallisation will be driven off (and the material will darken in colour).

When the copper sulphate has become white, or very slightly grey, the heating is stopped, and after cooling the crucible is weighed. A gentle heat is again applied for a few minutes, and the crucible weighed again. If the weight has not decreased by more than 1 centigram, it may be taken as constant, and the experiment finished. If the decrease is large, the crucible and contents must be again heated, etc. The weighings are entered and the calculation is made in a precisely similar way to that described for the action of heat upon potassium chlorate (Vol. I., p. 210, Experiment XV.).

The result is 36·2 per cent.

The percentage of water of crystallisation in washing soda, Glauber's salt, and barium chloride may be determined in a similar manner. When the behaviour of the substance towards heat is not known prior to the determination, a crucible lid should always be used. During the first stage of the heating, the lid should be so placed that it nearly, but not completely, covers the top of the crucible.

Some substances containing water of crystallisation give off some of the latter to the air in considerable quantity; at the same time they often become opaque and covered with a powder-like substance. This phenomenon is known as "efflorescence," and is well shown by washing soda. On the other hand, some substances take up water from the air; they are said to be "hygroscopic." If in taking up water the substance runs to a liquid, it is further said to be "deliquescent." Quick-lime, sulphuric acid, nitrate of soda and calcium chloride are examples of hygroscopic substances; of these only the last two are deliquescent.

The Decomposition of Water.—*A. By the action of certain metals upon steam.*

That water is composed of hydrogen and oxygen was definitely concluded from the fact that it is produced by the combustion of hydrogen in air. Such a proof is called "*synthetical*," because the water was "built up" from hydrogen and oxygen. Another method of proof is called the "*analytical*," which means "breaking down" or decomposing.

We have already analysed or decomposed various substances by the action of heat, and the question presents itself: Is water amenable to such treatment? Does hydrogen oxide decompose when strongly heated?

Since hydrogen and oxygen unite with great violence to form water, and so much heat energy is liberated in the act, we should expect the oxide to be a very stable substance, one that could only be decomposed by heat with great difficulty. Our expectation is justified. Hydrogen oxide is an extraordinarily stable substance, but nevertheless it is decomposed at very high temperatures. The

action begins at about 950° C., it is appreciable at 1100–1200° C., and above 2500° C. it is complete. Such high temperatures are not easy to produce, and so for practical purposes other means of analysis have to be adopted.

Do we know any substances which might deprive hydrogen oxide of its oxygen? Heated metals combine with it to form oxides, so perhaps some of these would decompose steam.

Experiment XXXI.—*To pass steam over heated iron.*

The apparatus to be recommended consists of three parts: a vessel in which the steam is generated, a hard glass tube in which the steam comes in contact with the heated metal, and a trough and gas-jar to collect any hydrogen which may be set free. For the first, a short-necked flask, provided with a short inclined delivery tube, and a long open safety-tube, may be used.

The iron filings can be placed either in a hard glass tube or in an iron gas-pipe, heated on a small gas-furnace. A delivery tube connects it to the trough. The tube is first heated to a dull red heat and then steam is passed over it. As the neck of the flask is short, but little steam will condense before it reaches the tube; and as the delivery tube is inclined, any steam that does condense will flow back as water into the flask. Bubbles of gas soon come through into the trough, and these are collected in the usual manner, after the air originally present in the apparatus has been displaced. When tested, the gas is found to be hydrogen.

Iron + hydrogen oxide = hydrogen + iron oxide.

The iron in the tube will not materially alter in appearance, because the oxide formed is very similar to it in appearance. On turning down the gas flames beneath the tube, bubbles of air will be observed to enter the apparatus through the long safety-tube; but for this, or if for any reason the internal pressure suddenly became diminished, cold water from the trough would rise into the heated glass tube and crack it.

The only other common metal which decomposes steam at a comparatively low temperature is magnesium, but in this case the action is violent and a glass apparatus would suffer. Magnesium + steam ⇒ hydrogen + magnesium oxide. Heated copper is without action on steam at 100° C.

B. By the action of potassium and sodium.

About a century ago Sir Humphry Davy isolated two metals, potassium and sodium, which differed from all other metals then known by their softness, their lightness, the readiness with which they corroded, and by their property of being able to decompose water at the ordinary temperature.

As the actions are very violent, the experiments should be performed on a small scale, in open vessels.

Experiment XXXII.—(*a*) *The action of sodium on water.*

A piece of sodium, about the size of a small pea, is thrown upon water contained in a small dish or earthenware trough. It immediately assumes a spherical shape, darts about on the surface and makes a hissing sound, due to the escape of hydrogen. If kept in one position, sufficient heat will accumulate to ignite the hydrogen, or the latter may be fired by applying a light: the yellow flame is due to the presence of sodium oxide, as a little of the metal is vaporised and burns in the air. The experiment may be repeated. The water acquires a bitter taste and has a caustic action on the skin, and the power of turning red litmus blue. It contains caustic soda, which may be recovered by evaporation.

Sodium + hydrogen oxide = hydrogen + sodium hydroxide.

Experiment XXXIII.—(*b*) *Action of potassium upon water.*

The course of this reaction is very similar to that just described. There are, however, one or two points of difference. The liberated hydrogen ignites of its own accord; it burns with a violet flame, due to the presence of potassium oxide; and the alkali left in the residual water is caustic potash or potassium hydroxide.

The action of potassium is, therefore, more energetic than that of sodium. Potassium + hydrogen oxide = hydrogen + potassium hydroxide.

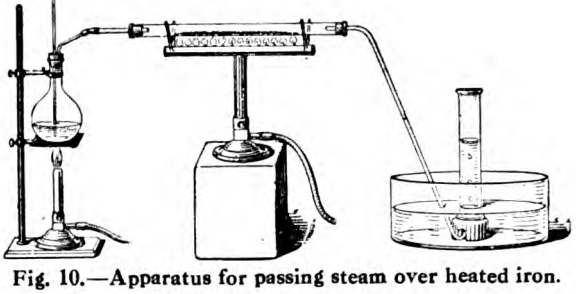


Fig. 10.—Apparatus for passing steam over heated iron.

It will be noted that neither of these metals displaces the whole of the hydrogen from the water they decompose; one-half of it only is set free in each case, the other half entering into the composition of the alkali produced. It is possible by certain means to liberate the hydrogen from the hydroxide, and it is then observed that its volume is equal to that evolved by the action of the metal upon the water. As the name implies, a *hydroxide* contains hydrogen and oxygen besides a third substance.

C. By the action of electricity.

Sir Humphry Davy effected the isolation of the metals potassium and sodium by decomposing their hydroxides, in a molten condition, with an electric current. Decomposition by electricity is called "*electrolysis*," and the substance is said to be "*electrolysed*." It is found by experiment that no substance can be electrolysed unless it conducts electricity, i.e. allows the current to pass through it. Now, pure water is practically a non-conductor, and its decomposition can only be brought about by the addition of some other kind of matter to render it a conductor. Sulphuric acid is usually employed for this purpose. The following experiment, therefore, does not, strictly speaking, represent the electrolysis of water.

Experiment XXXIV.—*To decompose water by electricity.*

Acidulated water is placed in the apparatus depicted in Fig. 11. It consists of a U-tube pro-

vided with a central limb which acts as a reservoir. The tops of the limbs of the U-tube are provided with taps, and their lower ends each contain a strip of platinum foil, welded on to platinum wire which is fused through the glass. These pieces of platinum are called the "*electrodes*"; they are exactly alike, and by means of insulated wire are connected to an electric battery consisting of three Grove's cells or two or three accumulator cells.

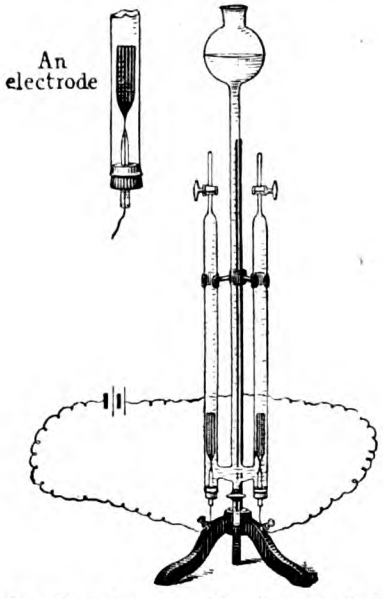


Fig. 11.—Apparatus for decomposing water by electricity.

The electrode at which the current enters is called the "*anode*," that at which it leaves is termed the "*cathode*." It is obvious that either electrode can be made the anode or cathode by the manner in which it is connected to the battery.

When the connection has been made, bubbles of gas collect on the electrodes and then rise through the water to the upper parts of the tubes. It is soon observed that the gas which comes from the cathode has a volume exactly double that which arises from the anode. These gases are then tested. The former is found to light with a pop and burn with a nearly invisible bluish flame (hydrogen); the latter rekindles a glowing spark (oxygen). Therefore—

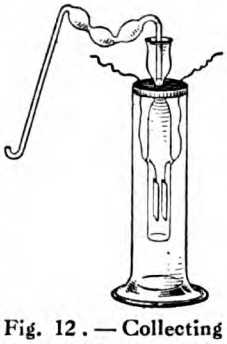


Fig. 12.—Collecting electrolytic (a highly explosive) gas.

When water (acidulated) is electrolysed it yields 2 volumes of hydrogen to 1 volume of oxygen.

This result can be confirmed by exploding a mixture of the two gases confined over mercury or water in a graduated tube, through the upper part of which two platinum wires are fused which nearly meet inside. The electric spark is passed between the wires. The apparatus is called a *eudiometer* (Fig. 13). Whatever volumes of the two gases are initially confined in the tube and exploded, it is always found that 2 volumes of hydrogen unite with 1 volume of oxygen to form hydrogen oxide.

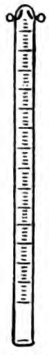


Fig. 13.—A Eudiometer.

If water be electrolysed and the two gases collected by means of a single delivery tube (Fig. 12), the resulting mixture, called "*electrolytic gas*," is a very explosive one. (The bulbs in the delivery tube are for holding sulphuric acid, when dry electrolytic gas is required.)

The safest way to illustrate this properly is to pass the mixture into a little soap solution contained in a small mortar. The delivery tube is then withdrawn, and a lighted taper applied to the bubbles. This explosion, as, indeed, all others, is caused by the very sudden liberation of a mass of gas which is highly heated and which, therefore, expands very rapidly. It is possible that the great energy contained in electrolytic gas may be utilised as a source of power for internal combustion engines. E. H. T.

HEAT.—VIII

36. Evaporation.—It is a familiar fact that water or other liquids gradually disappear if left in vessels exposed to the air, and that wet objects more or less slowly become dry. There is thus a process going on constantly, by which the liquid is slowly turned into an invisible form or *vapour*; this process goes on silently and from the surface of the liquid only: it is known as *evaporation*.

This change takes place at all temperatures. But the rate of evaporation is not always the same; it depends on the temperature, and also on the condition of the air.

If a dish containing water be enclosed under a bell-jar, evaporation will go on up to a certain point, at which it will completely cease. At that point, the air in the jar is said to be *saturated* with the vapour of the water; and, when the air is thus saturated, no more evaporation will take place. Clearly, then, there will be little evaporation on a day when the air is already almost saturated with water-vapour. But suppose the saturated air in the bell-jar is replaced by a supply of dry air; evaporation will then begin again and continue till the new air is saturated.

Evaporation, being a superficial process, will clearly go on more rapidly from a wide vessel than from a narrow one. But if the vessel is enclosed in a bell-jar, no more water will disappear from the one than from the other; the air becomes saturated more quickly in the one case than in the other—that is all.

More vapour is required to saturate a large quantity of air than a small quantity, so that more evaporation will take place in the open air than in a closed space filled with the same air at the same temperature. Conversely, if a quantity of saturated

air is compressed, less vapour will be required to saturate the smaller volume; consequently, some of the vapour will condense into the liquid form. This is a characteristic of all vapours: under sufficient pressure they can be restored to their liquid state.

The vapour given off from a liquid during evaporation is in many respects like a gas. In particular, it exerts a pressure, known as the *vapour-pressure* of the liquid. At a given temperature, this pressure has a constant value when the saturation point is reached, which we may speak of as the *maximum*

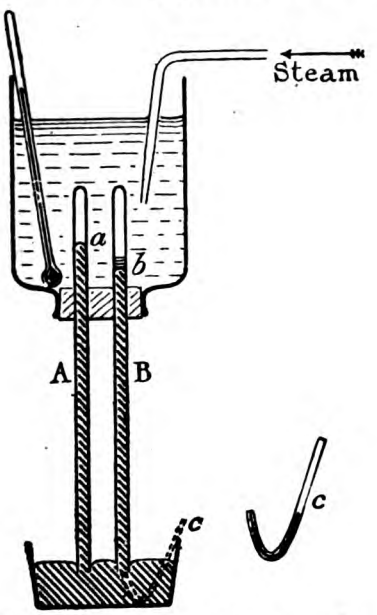


Fig. 49.—Apparatus for measuring vapour pressure.

vapour-pressure. This maximum vapour-pressure does not depend upon the gas into which the liquid is evaporating. Thus saturated water-vapour, for example, has the same vapour-pressure in a vacuum, in air or in hydrogen, or in any gas that does not act chemically on the water. It is a pressure added to that of the gas itself. If, for example, the air is saturated when the barometer indicates a total pressure of 750 *mm.* at a temperature of 14°, 12 *mm.* of this pressure is due to the water-vapour, and the real pressure of the air itself is only 738 *mm.*

The only factor that causes the maximum vapour-pressure of a liquid to change is an alteration of temperature. As the temperature rises, the vapour-pressure rises too; more evaporation goes on, as we know, when a liquid is heated: on a warm day drying is more rapid, *ceteris paribus*, than on a cold day.

Several methods can be suggested for the measurement of vapour pressure, and for verifying the statements made above. We shall describe one.

We take two barometer-tubes and set them up as barometers in the same dish of mercury. The upper parts of these tubes, i.e. where the vacua are, are enclosed in a water jacket, which may be formed, as indicated in Fig. 49, from a broad-mouthed bottle with the bottom removed. The barometer-tubes pass through the cork into the water, as shown. Into the water a tube is led from a can of boiling water, the steam passed heating the water to any desired temperature.

The tube, *a*, is kept as a true barometer, by means of which the pressure of the atmosphere can be read. Into the vacuum of *b*, however, a few drops of the liquid to be experimented on are introduced, by means of a tube bent as in *c*. This is filled with the liquid until the short arm overflows; the short arm is then introduced beneath *b*, and a little liquid carefully blown into the mercury: this will rise to the top of the mercury, and its vapour will saturate the vacuum. Care must be taken that a little of the *liquid* remains as such on the surface of the mercury at *b*.

When these arrangements are complete, we should notice that the level of *b* falls steadily below that of *a*, until a steady position is reached. The difference between the two heights is obviously due to the pressure of the vapour in *b*, and this difference can easily be measured in millimetres. We thus obtain the maximum vapour-pressure of the liquid, at the temperature of the jacket, in millimetres of mercury, the usual unit employed in measuring gaseous pressures. Passing steam into the water, we can obtain the maximum vapour-pressure at any temperature below 100°. The kind of results obtained for different liquids at different temperatures is shown in the following table:—

Temp.	Pressures in *mm.* of Mercury		
	Water	*Alcohol*	*Ether*
10°	9·1		
20°	17·4	44·5	432·8
35°	41·9		760
50°	92·0	219·9	1264·8
80°	354·4	760	
100°	760	1697·6	4953·3

It will be observed, as we should expect, that those liquids which are quickest to evaporate have the highest vapour pressure. It will also be observed that the vapour pressure becomes equal to that of the atmosphere at the boiling-point of the liquid.

37. Boiling.—When evaporation takes place from all parts of a liquid, and not merely from the surface, the liquid is said to boil. The action of boiling is probably set up by the presence of dissolved air in the water; the air, trying to escape, forms bubbles which become saturated with vapour; and when this vapour has a pressure great enough, the bubbles rise and burst at the surface. The pressure required must at least equal the pressure of the atmosphere; so that we may define the boiling-point of a liquid as that temperature at which the vapour-pressure of the liquid becomes equal to the pressure of the atmosphere. But a

liquid purified from dissolved gases can often be super-heated above its normal boiling-point without actually boiling. When the liquid is in this condition, a slight shake or a foreign substance will set it boiling violently. There is always a tendency for liquids to become super-heated, but the presence of a foreign body completely prevents this. A stone placed in a kettle will ensure the water against boiling with bumping, probably because of the small bubbles of air that adhere to it.

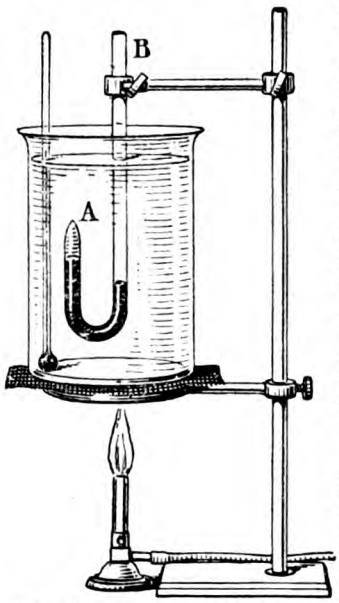


Fig. 50.—An accurate and instructive method of determining the boiling-point of a liquid.

In order to determine the boiling-point of a liquid, the method adopted in Lesson II. (Vol. I., p. 151) is the easiest; but the following method is both accurate and instructive. A piece of glass-tubing is bent into the siphon form and the short arm closed as in Fig. 50. In the short arm a small quantity is enclosed by means of a quantity of mercury, all air being carefully excluded. The mercury in B must

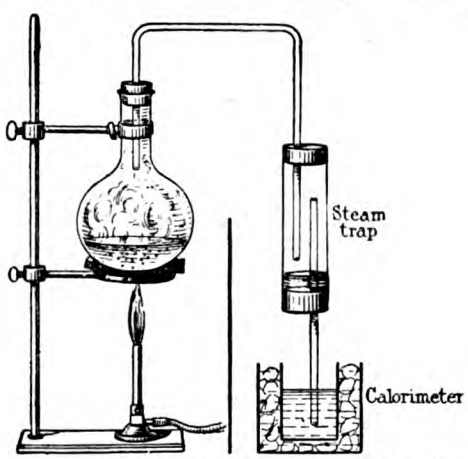


Fig. 51.—Apparatus for ascertaining the latent heat of steam.

at first be at a lower level than that in A. The whole apparatus is then placed in a beaker of water, with a thermometer. As the water is heated, the liquid in A begins to evaporate; its vapour exerts its vapour-pressure, tending to push the mercury down, till the point is reached when the pressure of the vapour in A is such that the mercury-level is equalised in A and B. The pressure of the vapour in A then balances the atmospheric pressure on the mercury in B, i.e. the liquid is at its boiling-point. The temperature can be read accurately when the levels have adjusted themselves.

The intimate dependence of the boiling-point upon the pressure can be shown by the following simple experiment. Boil some water in a round-bottomed flask; remove from the flame, and while the steam is still coming off close the flask with a good cork. The water at once ceases to boil. Invert the flask in a ring support (Fig. 52), and wait till bubbling again ceases. Then throw some cold water over the flask, and the water in the flask will begin to boil violently and continue to do so for a long time so long as cold water is applied to the flask. Take the cork out of the flask and notice that the temperature of the water is as low as 15°—20°. When the flask was closed, much of the air that was in it originally had been driven out by steam; the cold water caused a sudden condensation of some of this steam, and thus reduced the pressure on the water in the flask. At the reduced pressure, the water was thus able to boil at a lower temperature. From the table given in § 36, it will be gathered that, if the pressure were reduced to 17·4 *mm.*, water would boil at 20°, and this can be attained quite readily in an experiment such as we have described.

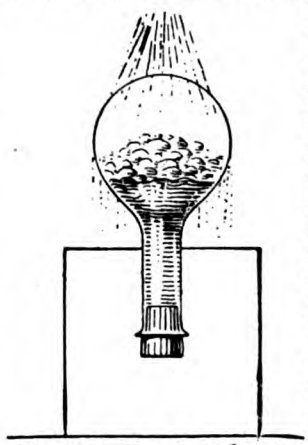


Fig. 52.—To demonstrate the dependence of boiling point on pressure.

38. Latent Heat of Vaporisation.—As evaporation is a change of state, we should expect latent heat to be absorbed in the process, and it is a familiar fact that evaporation produces cold. If a little ether, for instance, be poured on the hand, and the hand swung vigorously round, a feeling of intense cold is perceived, due to the rapid evaporation of the liquid. The amount of latent heat used up in evaporation is very considerable, so that the cooling produced by it is also considerable. If a watch-glass containing ether be placed on a wet table, and the ether rapidly evaporated from it by means of a bellows, the glass freezes to the table through the cold produced in the water by the rapid loss of heat from it.

To determine the latent heat of steam, we lead a current of steam at 100° into a calorimeter containing a weighed quantity of water. When a convenient rise of temperature has been observed, the current of steam is stopped, and the calorimeter again weighed. We thus obtain the weight of steam

which produces a known rise of temperature in a known quantity of water.

Example :—
Weight of water = 108 grams.
Temperature of water = 12°.
Weight of steam = 7 grams.
Final temperature = 50°.
Let x = latent heat of steam.
Then, total heat given out by steam in condensing = $7x$ cals.
And heat given out by water formed in falling from 100° to 50° = 7×50 cals.
Also, heat received by cold water, rising from 12° to 50° = 108×38 cals.
$\therefore 7x + 350 = 108 \times 38 = 4104$.
$\therefore 7x = 4104 - 350 = 3754$.
And $x = 536{\cdot}3$.

In the experiment, precautions have to be taken that nothing but steam enters the calorimeter; water is apt to condense in the delivery-tube, and thus to falsify the result by getting into the calorimeter. This may be avoided with care in the simplest apparatus; but sometimes the trap figured in Fig. 51 is used to ensure that only steam is led into the calorimeter. The steam must be allowed to run for some minutes before the delivery tube is dipped into the water in the calorimeter. All the tubes then rise to 100°, and there should be no condensation. E. W. E.

ASTRONOMY.—IX

EVERY student of astronomy will wish to possess a telescope of his own and inquiries are very often addressed to observatories for information as to the best telescope to be obtained for a definite sum, or as to what may be seen with a telescope of a certain size. A few remarks upon these matters may perhaps be useful. But it must always be remembered that more depends on the eye behind the telescope than on the size of the telescope itself, and that a trained observer can see more with a small instrument than the untrained can with a large one.

It is probable that most people looking through a telescope for the first time experience a certain disappointment, because they do not see as much as the illustrations in books on astronomy lead them to expect; they forget that such illustrations represent the work of the trained man making use of rare and exceptional conditions for observation during those rare moments when the usually unsteady air has quieted down a little, allowing the rays of light for the stars and the planets to pass through without too much interference. We have in general to put up with a degree of unsteadiness in the telescopic image which detracts very largely indeed from what the telescope is capable of at the best moment.

We have to remember also that a great deal of success depends on the comfort of the observer, and that generally it is much more difficult to observe comfortably with a small telescope than with a big one.

We will speak first of the refracting telescope, in which an image formed by the object glass is examined by a magnifying eye-piece. The degree of magnification of the telescope naturally depends upon two factors: the size of the first image which is formed, and the amount that it is magnified by the eye-piece. Now the size of the first image depends upon the focal length of the object glass, and not at all upon its size. Quite a small lens can be ground with gentle curves to have a very long focal length and give a correspondingly large image. But there are two excellent reasons against going very far in this direction.

Telescopes for Amateurs

In the first place, the longer a telescope the more difficult it is to mount and to manage. And secondly, the greater the focal length for a telescope of given aperture, the fainter is the image of an extended surface, such as a planet or a nebula, the brightness of the image varying inversely as the square of the focal length. An object glass of ten feet focal length will give an image of a planet twice as large as a five-foot object glass will do, but of only one-quarter the surface brightness. Hence there are no considerable advantages and several grave disadvantages in making the focal length of a telescope more than about twelve times its aperture, while for work on faint objects of considerable extent, such as nebulæ or comets, it is essential not to exceed the ratio of ten to one.

The power of the eye-piece used to magnify the image formed by the objective, depends on the construction of the lenses. Theoretically, there is scarcely any limit to the magnifying power of an eye-piece; but practically there are very strict limitations to the power which can be usefully employed.

To get high powers one must increase the curvature of the lenses and bring them closer together. This means that the lenses must be smaller in diameter for higher powers, or it will not be possible to bring them sufficiently close together. But a reduction in the size of the eye-piece lens on which the light first falls, called the field lens, diminishes the size of the field of view which can be examined at one time. Consequently, it is a mistake to try to push magnifying power of the eye-piece very far, and one generally finds that with the ordinary condition of

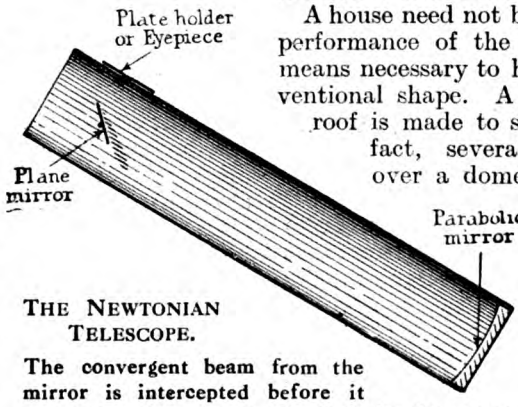
moderately unsteady seeing a total magnifying power of 50 for each inch of aperture of the objective is the most that can give satisfactory results, while on many objects, especially extended objects like nebulæ, this is far too much. A telescope will always be provided with a series of eye-pieces of different magnifying powers, and it is usual to begin with a low power and to work up to a higher if the performance of the low power is quite satisfactory.

The price of a refracting telescope goes up very rapidly in proportion to its aperture. Thus, an object glass alone, without any tube or eye-pieces or mounting, will cost, if it is of the highest quality, about the following amounts :—

3-inch aperture	£20.
4-inch aperture	£38 10s.
6-inch aperture	£95.

And the cost of mountings and accessories goes up at least as fast, so that a telescope of very moderate size is quite a costly affair.

Then we have to consider the mounting. The small telescope which is carried out on to the lawn is generally mounted upon a tripod stand, occupying a great deal of space underneath the telescope where the observer would like to be, and making it difficult to point to objects high up in the sky. But even before the stand begins to interfere with the actual pointing of the telescope, it becomes impossible to look up the tube except at very grave inconvenience, and it is necessary to have a diagonally reflecting eye-piece which shall turn the light out at right-angles to the tube.



THE NEWTONIAN TELESCOPE.

The convergent beam from the mirror is intercepted before it comes to a focus by an elliptical plate by means of which the light is sent out at right angles to the telescope, so that one can look, almost horizontally, at the heavens through the eye-piece in the side of the tube.

Then there comes the question of giving the telescope the various motions necessary to find a star and to follow it as it passes west. The cheaper forms of telescope have a vertical and a horizontal motion, each controlled by a handle. But since the motion of a star, except for a short while on the meridian, is neither altogether vertical nor altogether horizontal, it is necessary to be turning both these handles all the time.

A better telescope will have an equatorial mounting, one axis pointing up to the pole of the sky, and a second at right-angles to it, so that the diurnal motion of the star is followed by turning only about the first axis. This is far more convenient, but requires a heavier mounting, so that a telescope of about four-inch aperture, mounted equatorially, is as much as a strong man can carry. There is the further difficulty that the effect of the equatorial motion is very largely lost unless the instrument is set up in proper adjustment, with the polar axis really pointing to the pole and not to a point of about the same altitude somewhere else in the sky.

A portable equatorial telescope is, therefore, somewhat of an anomaly. By the time one has reached the stage of having an equatorial mounting, one has arrived at the point of needing a telescope house in which the instrument can be protected from the weather without being disturbed.

A house need not be costly. For the good performance of the telescope, it is by no means necessary to have a dome of the conventional shape. A building in which the roof is made to slide right away has, in fact, several decided advantages over a dome, for it is better ventilated, and there is not so much chance of disturbing the performance of the telescope by currents of hot air rising out of the shutter opening. The observer is, however, somewhat more exposed to the weather and the instrument more likely to be troubled with dew.

If one does have a dome, there are two important points to be kept in view. First, the shutter opening, which allows the telescope to look out, must be carried to its full width well beyond the zenith, and not taken up to a point at the zenith, as used too often to be done. And secondly, the circular rail on which the dome will turn must be strong enough to keep its shape, and carried on sufficient walls. A very frequent defect of small domes is that the walls are not really strong enough to carry the roof ; the circular horizontal rail gets distorted, and the dome will not turn.

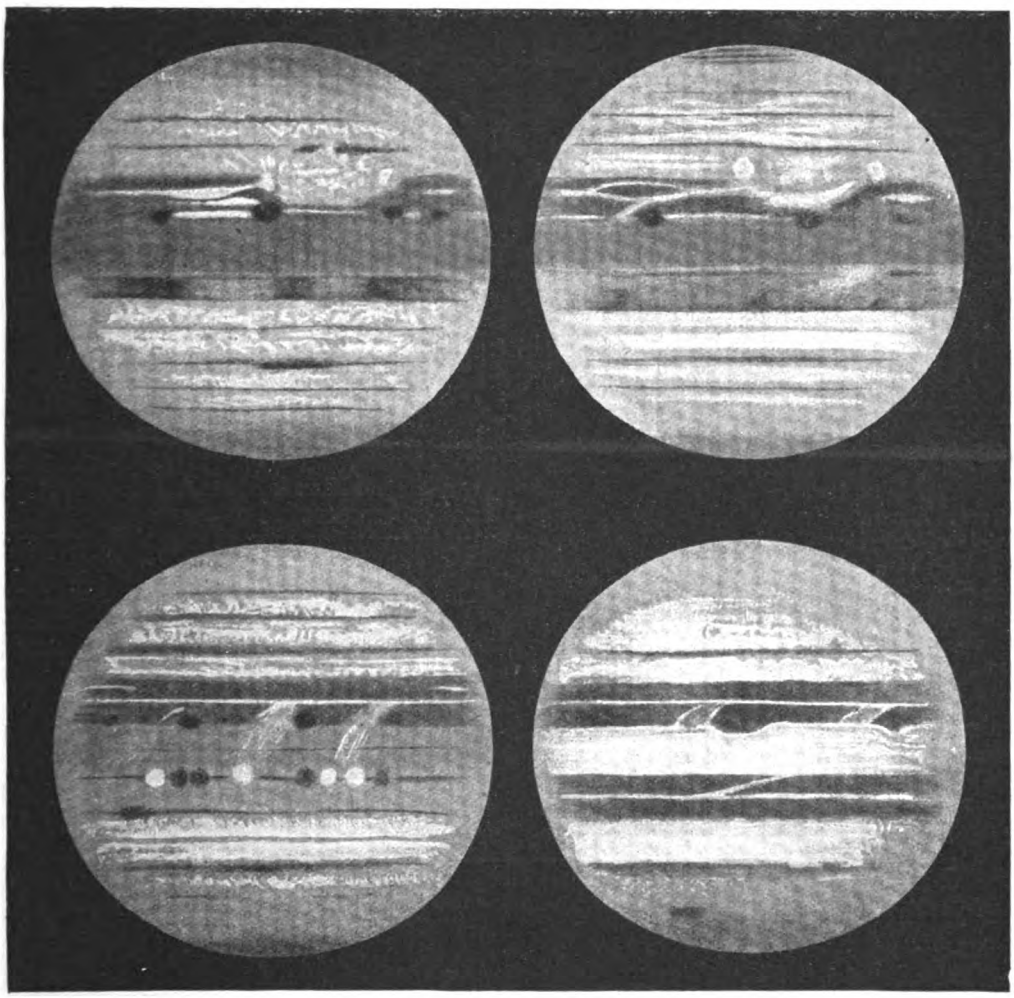
An astronomer who is not, in addition, a good deal of a mechanic, and who does not find much pleasure in making adjustments and silvering mirrors, will be well advised to

have a refracting telescope. But anyone who is fond of the workshop, and enjoys continually pulling the instrument to pieces, will remember that he can get a very much larger reflecting telescope than he can a refractor for a given sum of money.

Yet the reflecting telescope wants a good deal of care. It is a good deal more difficult to keep in adjustment, partly because it is often necessary to remove the mirror for re-silvering, which involves a good deal of re-adjustment before the telescope is again in use. By far the greater number of medium-sized reflecting telescopes are of the Newtonian construction, in which the convergent beam from the mirror is intercepted before it comes to a focus by an elliptical flat placed in the centre of the tube at 45° to the axis. The light is thus sent out at right-angles to the telescope, and the eye-piece or the photographic plate-holder is carried on the side of the tube.

This arrangement enables one to work looking nearly horizontally instead of looking up at a great angle to the horizon; and this is far more comfortable. On the other hand, when the reflector becomes larger than about twelve inches in diameter, it becomes a matter of some little difficulty to arrange a platform that shall bring the observer up to the height of the eye-piece in any desired position of the telescope, without fouling the mounting at one point or the other.

The choice between a refractor and a re-



THE PLANET JUPITER

with its varying appearance provides an interesting field of investigation for young astronomers. The surface currents which break up its cloud envelope into belts are by no means fully worked out. Above are four strikingly divergent views of the planet.

flector will depend, to a great extent, upon the class of work which it is desired to perform. If the owner of the telescope is ambitious to make measurements, such as of double stars, for example, then the refractor is by all means to be preferred. If, on the other hand, he wishes to obtain the best possible views of the planets and the nebulæ, he will do better with a reflector, which is superior on the planets because it is perfectly achromatic instead of only partly so, and which is better on the nebulæ because it can be constructed with a smaller ratio of focal length to aperture, gives brighter images for a given aperture, and permits the more readily of using an eyepiece with a considerable field of view.

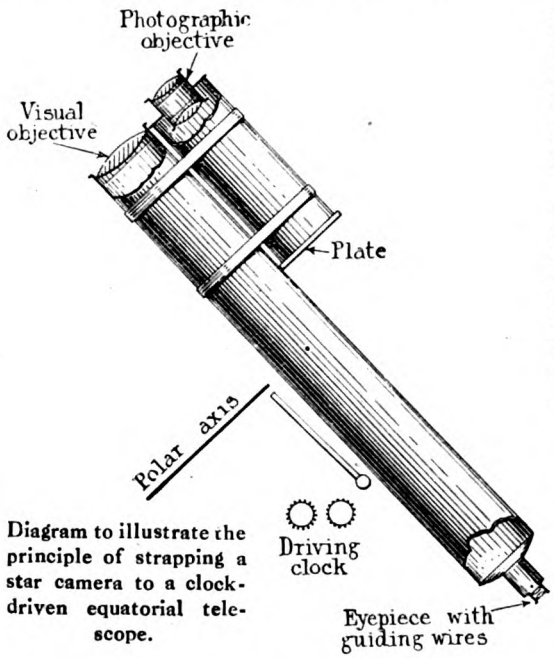


Diagram to illustrate the principle of strapping a star camera to a clock-driven equatorial telescope.

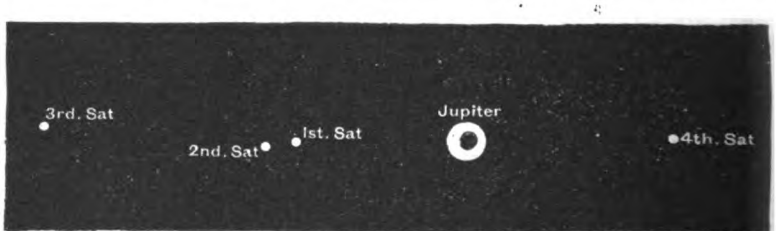
Should the owner be ambitious to try his hand at celestial photography he will find that it is an expensive matter to obtain a mounting and clockwork sufficiently good for work on anything like a large scale, and if his object is to take small scale views of large areas of the sky he will do best with a star camera strapped to the tube of an equatorial telescope, which serves to control the guiding and to keep the star images from wandering ever so little on the plate.

It remains to say a word on the fields of work in which a modest telescope can do something creditable.

By far the easiest way to make a name in astronomy is to discover a comet which eventually proves to be a famous object, such as that found by Donati at Florence in the year 1858. It is a good rule among astronomers that the name of the discoverer is attached to the comet, and several men who are now in the front rank have first come into prominence by their assiduity in this line of work, which requires principally an everlasting patience and perseverance.

It is work that can be pursued only when the moon is absent, and consequently often involves sitting up to late hours of the morning. It requires a telescope of low power, giving a bright image, and a good catalogue of nebulæ. The comet-seeker will spend most of his time discovering well-known nebulæ, which had better be identified at once in the catalogue and dismissed, rather than watched for half an hour to see if they are moving among the stars and so really are comets. To be a good comet discoverer one must have all the attributes of the patient sportsman, neither discouraged by long want of success in discomfort, nor too much disappointed when one finds that the coveted bag has fallen to another.

Those who prefer less exciting but more modestly productive work will turn rather to such investigations as the observation of variable stars, in which there is a very large field for individual effort. The discovery of new variables among the fainter stars may, with some reason, be left to the wholesale methods of photography, but every new variable star that is discovered by photography and put in the catalogue demands continued patient observation before the laws of its variability can be established, and this work is very suitable for the modest telescope.



The planet Jupiter, and its four satellites as seen through a low power telescope.

Another field of some fruitfulness lies in the study of the surface markings of the planets, especially of Jupiter, and in recording the times and the circumstances of the

eclipses, the occultations, and the transits of Jupiter's satellites. The surface currents, which break up the presumed cloud envelope of Jupiter into belts, and which carry with them at varying rates the spots, both bright and dark, into which those belts are often resolved, are not yet by any means fully worked out, and a study of astronomical literature will show that much valuable work has been done on this subject in recent years by telescopes of comparatively modest dimensions.

The belts, spots and markings on Jupiter vary a great deal in appearance and velocity. It is suggested that they are atmospheric formations floating in currents above the surface of the planet. The currents flow in a due east and west direction—a direction caused, it may be, by the rotatary movement of the planet. They do not merge into each other, but remain clearly bounded and controlled.

For many years the prediction of the phenomena of Jupiter's satellites has been far from satisfactory, owing to the absence of sufficiently good tables upon which to work. This has now been remedied, and the predictions in the Nautical Almanack are much improved, so that for a good many years it will be worth while to concentrate observation upon these events in order to provide for a full test of the adequacy of the tables.

Finally, there is, of course, always the Sun as an inexhaustible field of inquiry. In the preceding lesson we touched upon the fascination of direct observation of such phenomena as the colour effects and the shadow bands which precede the coming of the shadow of the moon at totality. We will now mention continuous photographic study of his surface features.

This, carried on at several well-equipped observatories, gathers up, no doubt, a considerable part of the facts, but there must be many striking events in the growth and decay of sun spots, or in the sudden formation and bewildering motions of the prominences which escape the official attention, and these are always worth waiting for and recording. The study of the Sun has further the very considerable practical advantage that it can be pursued only by day, and in fine weather, and is especially productive in the early morning hours which one might otherwise waste in bed. A. R. H.

Photo by author.

AFTER AN ECLIPSE.

A striking photograph showing the so-called Vadso clouds preventing observation immediately after a total eclipse of the Sun.

ANTHROPOLOGY.—II

OUR human ancestors began their career as insect-eaters, and remained insect-eaters in some respects down to the early stages of *Homo sapiens*—to this day the Australoids of Australia and the Negroes of Tropical Africa devour beetle-grubs, caterpillars, gnats, termites and even lice !

But in the ascent upwards ancient kinship with the primitive ungulates was not wholly untraceable : we show it still in our flattened nails. Through nearly all the Monkey stages these creatures with the human impetus liked to eat succulent shoots of leaves, ripe fruits, nuts and roots, but they were finding more and more attraction in the flesh of warm-blooded birds and small mammals, in the eggs of birds, lizards, crocodiles and snakes, in the appetising shell-fish of the banks of rivers or the seashore, and at a later date perhaps in the flesh of fish and lizards.

The Human Hand

Yet their teeth did not bear a carnivorous aspect. The flattened incisors in front (inherited from a hedgehog-like stage when we were saying good-bye to the divergent rodents) were much more suited to the gnawing of bark, the biting into fruits and nuts and roots, and the molars were better adapted for grinding this vegetable food ; than for severing blood vessels, tearing and masticating flesh. The eye-teeth or canines, it is true, were more formidable in appearance than those of modern Man, yet were not such fierce, long, sharp tusks as may be seen in baboons and anthropoid apes ; they were already growing shorter and blunter.

As a weapon of attack for the securing of living prey *the hand* was rapidly replacing the teeth of the typical carnivore. Yet this hand had the broad nails of the early ungulates and not the claws developed in some baboons, and on some fingers of the lemur or marmoset. *The hand* was becoming Man's great weapon, because it was more than ever the messenger of the brain. It was not suited to scratching and burrowing or to tearing with the nails as in earlier stages, but it could grasp far more strongly, it could **slap, strike and punch** and prod far more forcibly ; and above all it could *throw*.

The idea of *throwing*, which has meant so much for the development of Man, probably arose whilst our ancestors were not very dissimilar to the baboon or the macaque, which can hurl and chuck things about with a certain purpose. Whilst our forbears were still indistinguishable from the ancestors of the chimpanzee and the gorilla, they were probably able to throw sticks and fling stones with some accuracy of aim ; for this trait is still preserved by the degenerate apes of Africa. Our ancestral anthropoids who lived in the open regions of the Old World probably rose to eminence and to mastery over the other mammals by throwing stones—objectionable as this transmitted habit may be in the modern boy. They certainly flung sticks and heavy roots about, and in course of time without throwing they would aim a blow yet retain hold of one end of the heavy tree root, or of the long, pointed, or jagged branch, or sharp-edged stone, and *strike* with it.

Thus without the aid of long claws, long tusks, long jaws ; of a proboscis or of a huge tail ; or a prehensile tongue ; or a horn on the nose or the top of the head : they brought down their prey or they defended themselves against attack by objects extraneous to their person, that is to say, by using *weapons*.

There was something in this procedure so uncanny to the minds of the other mammals that this large anthropoid already began to inspire respect before he assumed definitely a wholly man-like aspect.

Man's Immediate Ancestors

He now walked, ran, stood, relatively upright, on powerful limbs, with slender legs and long, muscular thighs, with arms still comparatively long, with a great development of chest, rather a rigid back and stooping shoulders, a short neck, a large head, strong, prominent jaws, and the tendency to hairlessness on the body. His anthropoid brothers or cousins who had reverted to a wholly forest life, had retained their body hair and even developed it in great length and some thickness. But in the immediate ancestors of Man, though the whole skin, except that of the chest, hands, feet and cheeks, may have been more or less covered by a fine down (giving it a dull appearance at a distance), the long and coarse hair of the body was disappearing, except where it remained in a few tufts about glandular regions and on the top of the head.

Here it was growing longer and more luxuriant than in the apes. A good deal of hair also (but not so much as in some of our most modern types) was developing around the cheeks, chin and throat of the males.

The colour of the skin was probably in general a sickly yellow or a yellowish-brown. As to the colour of the body hair, it may have varied a good deal in local varieties; it may even have varied as regards sex and age. The females and young were, possibly, red-haired, with ashy-brown varieties; while the males tended more towards being black-haired, especially when adult. Yet no doubt there developed ever and again large tribes and considerable races of ancestral humans that were black-haired in both sexes, though they gave birth to children at first red-haired or brown-haired.

The growth of Man's brain when he took to this adventurous carnivorous life in the open, grew rapidly and disproportionately, so that his intelligence might enable him to cope with his many adversaries, victims and rivals. It grew far larger than in the cowardly anthropoids who had betaken themselves to the forests; in whose case, indeed, there has probably been actual degeneration. The shape of the skull and the comparative size of the brain in the young orang, chimpanzee and gorilla, are indications that their ancestors have known better days, have had a greater intelligence and a more human aspect of face.

Drawn by A. Forestier.

EOANTHROPOS DAWSONI.

A reconstruction of the head of the early inhabitant of Britain, whose remains were found at Piltdown, in Sussex—a creature with a brain equal in volume and nearly equal in quality to that of the most savage people known to us to-day—say the Veddahs of Ceylon.

So at last in our survey of Man's evolution we reach a stage in human development which is comparable to that of *Eoanthropos dawsoni*, whose remains were discovered not many years ago in Sussex—a creature with a brain equal in volume and nearly equal in quality to that of the most savage people known to us at the present day—say the Veddahs of Ceylon, the Congo Pygmies, or Bushmen of South Africa; yet with much more prominent jaws, an even flatter nose, and with eye-teeth or canines still showing the influence of the ancestral monkey in that they were not uniform in shape, size or range with the incisors. They were slightly separated from the incisors in front and the pre-molars behind, were sharp pointed and projected perhaps as much as a quarter of an inch beyond the uniform line of the other teeth.

Eoanthropos no doubt uttered a great variety of cries—screams, groans, hisses, barks, and growls—but it could not speak an articulate language. No doubt it was beginning to attach very definitely certain sounds to certain objects or subjects, and trains of thought; so that one kind of cry meant it had sighted a lion, another utterance imitated a snake, a third showed that it was hungry, a fourth exclamation that it was angry, a fifth that it was in love, a sixth that it was pleading for protection. A hiss suggested caution, a chuckle showed it was in fun (the chimpanzee already laughs boisterously), an inspiration of the breath or a clack of the tongue against the teeth expressed amazement. Such sounds were made with the lips, the palate, the uvula, throat, and tongue; and this potent shaper of Man's development no doubt clacked and clicked in eoanthropoid times noises very like those uttered by the modern Bushmen or Hottentots.

Eoanthropos was already knowing in the use of stone as a weapon or utensil. A creature of an earlier stage possibly, with a smaller brain and a more apelike aspect, yet with good stout legs and of an upright position, had already wandered from the place of remote human origins (somewhere between Europe, Syria, and North Africa) to southernmost Asia, where it has been revealed to us in Java under the name of *Pithecanthropos*, and where seemingly it lingered as a not quite human being long after the advent of real Man. *Homo sapiens* no doubt co-existed with it in Java much as he co-exists still with the anthropoid apes or as Europeans of the most modern

development now live alongside the Congo Pygmy in the heart of Africa.

What are the leading characteristics of Man, of the genus *Homo*, as contrasted with those of the Anthropoid Apes ?

The far greater dimensions in proportion of the skull-case, the size and weight of the brain ; the shortening of the face and jaws, the shorter arms and longer legs, the greater development of the thumb, the arrangement of the toes, of the foot, and of the loss of the prehensile power and position of the big toe, the lesser size in proportion of the thorax or chest-case, the number of ribs, the structure of the sternum or breast-bone. the curve of the spine, the greater development of the nasal bones and the growth of the nose and of the chin, the reduction of the eye-teeth or canines, and the size of the molars, the excessive growth of hair on the crown of the head, and on the chin (in the male), and the almost complete loss of hair on the body, the conformation of the liver, and the reduction of the appendix to the cæcum.

There are also certain differences, small but none the less important, in the reproductive organs.

There is in addition the great fact that Man has acquired by the development of certain lobes of the brain, and certain muscles of the tongue, the faculty of articulate speech.

The Birth of Man

But the whole value of these points of difference is barely that between one family of the mammalia and another. Indeed, in some directions the differences between the Anthropoids and the genus Homo are little more than that between one sub-family and another of the great order of the Primates.

But where was the real genus Homo born ? Where, in fact, was Man first created by the application of natural laws ?

Quite possibly, in Southern England or in France, or in Western Germany, or in Italy, or even in Syria or Mesopotamia where he had his origin in the early legends. In any one of these regions the Garden of Eden may have been situated. But it was probably very unlike the paradise of our subsequent imaginings. The birth of Man was as painful in travail of soul and body as is the normal birth of each individual human being, just as the long subsequent history of the modern human species has been well styled by Winwood Reade, "The Martyrdom of Man."

The genus *Homo* was probably shaped and perfected from out of the ape-like Eoanthropos by the first threatenings of the Ice ages, the coming of the cold, which was so profoundly to modify the northern and southern regions of the earth and which is still a dominant fact in the surroundings of humanity. It may quite well be that Eoanthropos scarcely knew what frost was unless he was impelled in some pressure of circumstances to seek for food on the highest plains of the Sussex mountains (now the Sussex Downs and barely a third of their altitude in the Pliocene period).

Here he may have lost his way and have had to spend the night shivering with the unwonted experience of 30° to 32° Fahrenheit. But his descendants in some part of northern or central Europe began to see the snow whitening the tops not merely of the Alps or the Carpathians or Pyrenees, but of lower ranges of mountains. Century after century became a little colder in the winter, a little less genial in the spring, till at last by leaps and bounds, by slow, slow progress (with occasional reversions to more genial weather) the climate of modern Greenland afflicted the greater part of Europe.

Food, Clothing and Shelter

The descendants of Eoanthropos were of the bulldog breed nevertheless, the breed that Europe has sent out into the world over and over again in its history. Instead of abandoning regions once so gloriously blessed with fruit, nut, root, fungus, and herb-yielding forest land, or the abundant and easily captured supply of birds, fish, squirrel and monkey, they attacked with ever increasing boldness the hairy elephants and rhinoceroses, the bison, musk-ox, reindeer, and other huge beasts which were gradually adapting themselves to the Arctic climate.

They conceived the idea of stripping the gluttons, the bears, the wolves, the sheep and chamois of their furry skins and throwing them about their own shivering limbs—limbs, it may well be, which still retained a good deal of the primitive hairy covering.

Knocking stones together to get sharp flakes with which to arm their weapons or to scrape the underside of fur or hide, they realised how to make fire artificially (the lightning and thunder-storms in earlier and happier ages had started many a forest fire or grass fire and thus had initiated the earliest human hunters into the charms of roast meat). They not only sought for and inhabited all the accessible caves, but they

THE GALLEY HILL MAN.

PITHECANTHROPOS.

THE HEIDELBERG MAN.

NEOLITHIC MAN.

Reproduced from the remarkable busts modelled by Louis Mascré, under the supervision of the eminent Belgian, Professor Rutot.

dug holes for themselves, they built wind shelters; and necessity being the mother of invention they laid the foundations of all the human arts and crafts.

Ever and again changes (as yet unexplained) in the climate would take place—usually slow for the most part in their coming about. The ice would retreat towards the North Pole, and a temperate or a semi-tropical climate lead to a great development of life and energy and change of species in Europe, Northern Asia and North America. In periods like these, Man, now master of creation, extended his wanderings farther and farther afield till he had penetrated all parts of the earth which could be reached from his original home without crossing wide straits of water. He had probably lost the instinctive power of swimming, owing to his adoption of the upright pose and the two-legged walk. He waded rivers when they were shallow; otherwise they bounded his migrations.

Photo in the Collection of the Royal Anthropological Institute.

A PRESENT DAY NATIVE OF NEW IRELAND,
in the Malay Archipelago, and closely akin, anthropologically, to the early ancestors of modern civilised man.

And was *Homo sapiens*, the existing type of the family *Hominidæ*, the only man-like descendant of the early anthropoids? By no means. There were, no doubt, not merely such preceding or divergent genera as *Pithecanthropos* and *Eoanthropos*, but other species of the true genus *Homo;* besides that which Linnaeus appropriately christened "the wise."

How many divergent types of *Homo* there have been, Science cannot yet say, probably may never be able to say; but we know of at least one other species of the genus distinct in type from us and from our ancestor in the early Pleistocene. This was the form now generally known as *Homo neanderthalensis*. The name is derived from the Valley of Neanderthal, near Düsseldorf, on the Rhine, where some sixty years ago a remarkable skull-case, teeth and limb-bones were found. Remains of a similar or allied type have subsequently been discovered in Austria, in the Upper Rhine Valley, in Belgian Luxembourg, at a great many places in France, in the Island of Jersey, and in a Gibraltar cave.

The Neanderthaloid man was much more ape-like in his limbs and spine but was more specialised than we are in his teeth. His canines were smaller and less prominent than those of modern man, and his molars were much longer in their downward growth and correspondingly shorter in the fangs. It is rea onable to assume, therefore, that the *Homo neanderthalensis* was not such a formidable type as was originally supposed. He was probably not the ogre that one at first imagined. His diet must have been chiefly vegetarian. H. H. J.

Continued from Vol. I., page 488.

LANGUAGES:

Contributors:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A. [Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).

LATIN.—IX

THIRD OR CONSONANT CONJUGATION—ACTIVE VOICE

Example.—Lĕgō, *I read;* bases, **lĕg-**, **lēg-**, **lect-**.

Chief Parts: Lĕg-**o**, lēg-**ī**, lect-**um**, lĕg-**ĕrĕ**.

Indicative Mood

PRESENT	IMPERFECT
Sing.	*Sing.*
lĕg-**ō**, *I read.*	lĕg-**ēbam**, *I was reading.*
lĕg-**ĭs**, *thou readest.*	lĕg-**ēbās**, *thou wast reading.*
lĕg-**ĭt**, *he reads.*	lĕg-**ēbăt**, *he was reading.*
Plur.	*Plur.*
lĕg-**ĭmŭs**, *we read.*	lĕg-**ēbāmŭs**, *we were reading.*
lĕg-**ĭtĭs**, *ye read.*	lĕg-**ēbātĭs**, *ye were reading.*
lĕg-**unt**, *they read.*	lĕg-**ēbant**, *they were reading.*

FUTURE	PERFECT
Sing.	*Sing.*
lĕg-**am**, *I shall read.*	lēg-**ī**, *I read* or *have read.*
lĕg-**ēs**, *thou wilt read.*	lēg-**istī**, *thou readest* or *hast read.*
lĕg-**ĕt**, *he will read.*	lēg-**it**, *he read* or *has read.*
Plur.	*Plur.*
lĕg-**ēmŭs**, *we shall read.*	lēg-**ĭmŭs**, *we read* or *have read.*
lĕg-**ētĭs**, *ye will read.*	lēg-**istĭs**, *ye read* or *have read.*
lĕg-**ent**, *they will read.*	lēg-**ērunt** (or **-ērē**), *they read* or *have read.*

PLUPERFECT	FUTURE PERFECT
Sing.	*Sing.*
lēg-**ĕram**, *I had read.*	lēg-**ĕrō**, *I shall have read.*
lēg-**ĕrās**, *thou hadst read.*	lēg-**ĕris**, *thou wilt have read.*
lēg-**ĕrăt**, *he had read.*	lēg-**ĕrit**, *he will have read.*
Plur.	*Plur.*
lēg-**ĕrāmŭs**, *we had read.*	lēg-**ĕrĭmŭs**, *we shall have read.*
lēg-**ĕrātĭs**, *ye had read.*	lēg-**ĕrĭtĭs**, *ye will have read.*
lēg-**ĕrant**, *they had read.*	lēg-**ĕrint**, *they will have read.*

Subjunctive Mood

PRESENT	IMPERFECT
Sing.	*Sing.*
lĕg-**am**, *I may read.*	lĕg-**ĕrem**, *I might read.*
lĕg-**ās**, *thou mayst read.*	lĕg-**ĕrēs**, *thou mightst read.*
lĕg-**ăt**, *he may read.*	lĕg-**ĕrĕt**, *he might read.*
Plur.	*Plur.*
lĕg-**āmŭs**, *we may read.*	lĕg-**ĕrēmŭs**, *we might read.*
lĕg-**ātĭs**, *ye may read.*	lĕg-**ĕrētĭs**, *ye might read.*
lĕg-**ant**, *they may read.*	lĕg-**ĕrent**, *they might read.*

PERFECT	PLUPERFECT
Sing.	*Sing.*
lēg-**ĕrim**, *I may have read.*	lēg-**issem**, *I might have read.*
lēg-**ĕris**, *thou mayst have read.*	lēg-**issēs**, *thou mightst have read.*
lēg-**ĕrĭt**, *he may have read.*	lēg-**issĕt**, *he might have read.*
Plur.	*Plur.*
lēg-**ĕrimŭs**, *we may have read.*	lēg-**issēmŭs**, *we might have read.*
lēg-**ĕritĭs**, *ye may have read.*	lēg-**issētĭs**, *ye might have read.*
lēg-**ĕrint**, *they may have read.*	lēg-**issent**, *they might have read.*

Imperative Mood

PRESENT.	FUTURE
Sing.	*Sing.*
lĕg-**ĕ**, *read thou.*	lĕg-**ĭtō**, *thou shalt read.*
	lĕg-**ĭtō**, *he shall read.*
Plur.	*Plur.*
lĕg-**ĭtĕ**, *read ye.*	lĕg-**ĭtōtĕ**, *ye shall read.*
	lĕg-**untō**, *they shall read.*

Infinitive Mood

PRESENT	PERFECT
lĕg-**ĕrĕ**, *to read.*	lēg-**issĕ**, *to have read.*

FUTURE

lect-**ūrŭs** essĕ, *to be about to read.*

GERUND	SUPINE
N. Acc. lĕg-**endum**, *reading.*	*Acc.* lect-**um**, *to read.*
Gen. lĕg-**endī**.	*Abl.* lect-**ū**, *in reading* or *to be read.*
Dat. lĕg-**endō**.	
Abl. lĕg-**endō**.	

Participles

PRESENT	FUTURE
lĕg-**ens, -entĭs**, *reading.*	lect-**ūrŭs, -ūrā, -ūrum** *about to read.*

FOURTH OR I-CONJUGATION—ACTIVE VOICE

Example.—Audīō, *I hear;* bases, **aud-, audīv-, audīt-.**

Chief Parts : Aud-**īō**, audīv-**ī**, audīt-**um**, aud-**īrĕ**.

Indicative Mood

PRESENT	IMPERFECT
Sing.	*Sing.*
aud-**īō,** *I hear.*	aud-**iēbam,** *I was hearing.*
aud-**īs,** *thou hearest.*	aud-**iēbās,** *thou wast hearing.*
aud-**ĭt,** *he hears.*	aud-**iēbăt,** *he was hearing.*
Plur.	*Plur.*
aud-**īmŭs,** *we hear.*	aud-**iēbāmŭs,** *we were hearing.*
aud-**ītĭs,** *ye hear.*	aud-**iēbātĭs,** *ye were hearing.*
aud-**iunt,** *they hear.*	aud-**iēbant,** *they were hearing.*

FUTURE	PERFECT
Sing.	*Sing.*
aud-**iam,** *I shall hear.*	audīv-**ī,** *I have heard.*
aud-**iēs,** *thou wilt hear.*	audīv-**istī,** *thou hast heard.*
aud-**iĕt,** *he will hear.*	audīv-**it,** *he has heard.*
Plur.	*Plur.*
aud-**iēmŭs,** *we shall hear.*	audīv-**ĭmŭs,** *we have heard.*
aud-**iētĭs,** *ye will hear.*	audīv-**istĭs,** *ye have heard.*
aud-**ient,** *they will hear.*	audīv-**ērunt** or **-ērĕ,** *they have heard.*

PLUPERFECT	FUTURE PERFECT
Sing.	*Sing.*
audīv-**ĕram,** *I had heard.*	audīv-**ērō,** *I shall have heard.*
audīv-**ĕrās,** *thou hadst heard.*	audīv-**ĕris,** *thou wilt have heard.*
audīv-**ĕrăt,** *he had heard.*	audīv-**ĕrit,** *he will have heard.*
Plur.	*Plur.*
audīv-**ĕrāmŭs,** *we had heard.*	audīv-**ĕrimŭs,** *we shall have heard.*
audīv-**ĕrātĭs,** *ye had heard.*	audīv-**ĕritĭs,** *ye will have heard.*
audīv-**ĕrant,** *they had heard.*	audīv-**ĕrint,** *they will have heard.*

Subjunctive Mood

PRESENT	IMPERFECT
Sing.	*Sing.*
aud-**iam,** *I may hear.*	aud-**īrem,** *I might hear.*
aud-**iās,** *thou mayst hear.*	aud-**īrēs,** *thou mightst hear.*
aud-**iăt,** *he may hear.*	aud-**īrĕt,** *he might hear.*
Plur.	*Plur.*
aud-**iāmus,** *we may hear.*	aud-**īrēmŭs,** *we might hear.*
aud-**iātĭs,** *ye may hear.*	aud-**īrētĭs,** *ye might hear.*
aud-**iant,** *they may hear.*	aud-**īrent,** *they might hear.*

PERFECT	PLUPERFECT
Sing.	*Sing.*
audīv-**ĕrim,** *I may have heard.*	audīv-**issem,** *I might have heard.*
audīv-**ĕris,** *thou mayst have heard.*	audīv-**issēs,** *thou mightst have heard.*
audīv-**ĕrĭt,** *he may have heard.*	audīv-**issĕt,** *he might have heard.*
Plur.	*Plur.*
audīv-**ĕrimŭs,** *we may have heard.*	audīv-**issēmŭs,** *we might have heard.*
audīv-**ĕrītĭs,** *ye may have heard.*	audīv-**issētĭs,** *ye might have heard.*
audīv-**ĕrint,** *they may have heard.*	audīv-**issent,** *they might have heard.*

Imperative Mood

PRESENT	FUTURE
Sing.	*Sing.*
aud-**ī,** *hear thou.*	aud-**ītō,** *thou shalt hear.*
	aud-**ītō,** *he shall hear.*
Plur.	*Plur.*
aud-**ītĕ,** *hear ye.*	aud-**ītōtĕ,** *ye shall hear.*
	aud-**iuntō,** *they shall hear.*

Infinitive Mood

PRESENT	PERFECT
aud-**īrĕ,** *to hear.*	audīv-**issĕ,** *to have heard.*

FUTURE

audīt-**ūrŭs** essĕ, *to be about to hear.*

GERUND	SUPINE
N. Acc. aud-**iendum,** *hearing.*	*Acc.* audīt-**um,** *to hear.*
Gen. aud-**iendī.**	*Abl.* audīt-**ū,** *in hearing* or *to be heard.*
Dat. aud-**iendō.**	
Abl. aud-**iendō.**	

Participles

PRESENT	FUTURE
aud-**iens, -ientĭs,** *hearing.*	audīt-**ūrŭs,-ūrā, -ūrum,** *about to hear.*

The learner will have observed that in these two conjugations the future is formed in a different way from that of the first two. It is of mnemonic value also to notice that the first person singular of the present subjunctive is identical in form with that of the future indicative. In the second and third persons the future indicative endings have **e**, while the present subjunctive endings have **a**. The forms of the imperfect subjunctive can be found by adding the endings of person and number, **-m**, **-s**, **-t**, **-mŭs**, **-tĭs**, and **-nt**, to the present infinitive in the active voice. Similarly the forms of

the pluperfect subjunctive may be found from the perfect infinitive.

Conjugate for practice the following :— like **lĕgō, inĭcĭō, -iēcī, -iectum**, *to throw in;* **mĕtŭō, mĕtŭī, mĕtūtum,** *to fear;* like **audĭō, sentĭō, sensī, sensum**, *to feel, to discern;* **vĕnĭō, vēnī, ventum**, *to come.*

Contracted Forms

When the perfect base ends in **v** this often becomes suppressed and a contraction of vowels takes place. Thus we get the alternative forms :—

Indicative Mood

PERFECT

ămāvistī, ămastī	**audīvistī, audĭistī** or **audistī**
ămāvistis, ămastis	**audīvit, audĭit** **audīvistis, audĭistis** or **audistis**
ămāvērunt, ămārunt	**audīvērunt, audĭērunt** **audīvērĕ, audĭērĕ**

(**ămāvērĕ** does not become **ămārĕ**, which might be confused with the Pres. Infin.)

PLUPERFECT

ămāvĕram, ămāram	**audīvĕram, audĭĕram**

FUTURE PERFECT

ămāvĕrō, ămārō	**audīvĕrō, audĭĕrō**

Subjunctive Mood

PERFECT

ămāvĕrim, ămārim	**audīvĕrim, audĭĕrim**

PLUPERFECT

ămāvissem, ămassem	**audīvissem, audĭissem,** or **audissem**

Perfect Infinitive

ămāvissĕ, ămassĕ	**audīvissĕ, audĭissĕ**, or **audissĕ**

A contraction sometimes takes place in the imperfect indicative of the fourth conjugation, **audĭēbant** becoming **audībant.**

Periphrastic Conjugation

The future participles in **-ūrŭs** may be conjugated with the verb **sum** in all its tenses, as follows :—

Indicative Mood

PRESENT

Sing.	*Plur.*
ămātūrŭs sum, ĕs, ĕst, *I am, thou art, he is about to love.*	**ămātūrī sŭmŭs, ēstĭs, sunt,** *we, ye, they are about to love.*

IMPERFECT

ămātūrŭs ĕram, *I was about to love.*	**ămātūrŭs ĕrō,** *I shall be about to love.*

PERFECT

ămātūrŭs fŭī, *I was* or *have been about to love.*	**ămātūrŭs fŭĕram,** *I had been about to love.*

FUTURE PERFECT

ămātūrŭs fŭĕrō, *I shall have been about to love.*

Subjunctive Mood

PRESENT

ămātūrŭs sim, *I may be about to love.*

IMPERFECT

ămātūrŭs essēm, *I might be about to love.*

PERFECT

ămātūrŭs fŭĕrim, *I may have been about to love.*

PLUPERFECT

ămātūrŭs fŭissem, *I might have been about to love.*

Infinitive Mood

PRESENT

ămātūrŭs essĕ, *to be about to love.*

PERFECT

ămātūrŭs fuissĕ, *to have been about to love.*

The participle in **-ūrŭs** agrees, of course, with its substantive in gender, number and case, and is regularly declined, fem. **-ūră**, neut. **-ūrum.**

Vocabulary

ăgo, ēgi, actum, 3, *to drive, to do, to pass (time).*
ălĭquandō, *at some time or another.*
ăn, *or, whether.*
ardĕō, -rsī, -rsum, 2, *to burn.*
căvĕō, cāvī, cautum, 2, *to beware.*
commūnis, -ĕ, *common, general.*
concĭlĭum, -ī, (n.), *meeting, assembly.*
contemnō, -tempsī, -temptum, 3, *to despise.*
dēpōpulo, -āvi, ātum, 1, *to spoil, lay waste.*
dērōgo, -āvi, -ātum, 1. *degrade, abate.*
dērumpo, -rūpi, ruptum, 3, *break off.*
dīco, dixī, dictum, 3, *to say.*
discēdo, -cessī, cessum, 3, *to depart.*
dōnō, -āvī, -ātum, 1, *to give, to present.*
empōrium, -i (n.), *a market town.*
ērīpĭō, -pŭī, -reptum, 3, *to take away.*
exercĭtŭs, -ūs (m.), *army.*
fēlix, -ĭcĭs, *favourable, happy.*
gĕnŭs, -ĕrĭs (n.), *birth, race, kind.*
gĕrō, gessi, gestum, 3, *to wage.*
hĕbes, hĕbetis,(adj.) *blunt, heavy, dull.*
inculco, -āvi, -ātum 1, *drive in, ram down.*
incursus, -ūs (m.), *an inroad.*
lēgātus, -ī (m.), *ambassador.*
lĭber, -brī (m.), *bark, book.*
lĭber, -ĕra, -ĕrum, *free.*
mĭser, -ĕrī, *wretched.*
nosco, nōvi, nōtum, 3, *to know, understand.*
nox, noctĭs (f.), *night.*
occŭpō, -āvī, -ātum, 1, *to seize, to occupy.*
odiōsus, -a, -um (adj.), *hateful, odious, unacceptable.*
offendo, -endi, -sum, 3, *to hit, miscarry, offend.*
oppugnatio, -ōnis (f), *assault, battery.*
părĭĕs, -ĕtĭs (m.), *wall.*
pĕcūnĭa, -ae (f.), *money.*
pĕr, *through.*
percĭpio, -cēpi, -ceptum, 3, *take, apprehend, perceive,*
perfĭdĭa, -ae (f.), *perfidy.*
plăcĕō, -ŭī, -ĭtum, 2, *to please.*
prōmulgo, -āvi, -ātum, 1, *noise abroad, publish.*
prora, -ae (f), *forecastle, prow.*
quanquam (quamquam), *although.*
quĕ (enclitic), *and.*
quŏnĭam, *since.*
rĕlinquo, -līquī, -lictum, 3, *to leave.*
rĕmittō, -mīsī, missum, 3, *to send back, to yield.*
rŏgō, -āvī, -ātum, 1, *to ask.*
sententĭă, -ae (f.), *opinion.*
stătim, *at once.*
succurrō, -currī, -cursum, 3, *to aid, to assist.*
tectum, -ī (n.), *roof, dwelling.*
virgō, -gĭnĭs (f.), *virgin.*

Exercise 9

Translate into English :—

1. Saepe hoc de maioribus natu audivimus. 2. Terrorem hostibus clamor nostrorum militum iniecit. 3. Quamquam omnia sunt metuenda, nihil magis quam perfidiam timemus. 4. Timor omnem exercitum occupavit. 5. Tua res agitur, paries quum proxima ardet. 6. Bono cuique miseris succurrere placet. 7. Carmina non prius audita virginibus puerisque canto. 8. Copiae neque numero neque genere hominum contemnendae. 9. Mihi liber esse non videtur qui non aliquando nihil agit. 10. Senatus Populusque Romanus unam eandemque sententiam dixit.

Translate into Latin :—

1. Africanus used to say that he was never so busy (did more) than when he was doing nothing. 2. Very high mountains hang over the city. 3. Never before this time did the people call a consul to trial. 4. Not only have we land but also a large number of slaves. 5. He said a good deal to me, and asked me for money. 6. Who wrote this letter ? 7. You, since it is already night, depart to your dwellings. 8. Verres gave me all the books that his brother left. 9. There are many people who take away from some that which they give to others. 10. Caesar is said to have had two thousand men in the camp before the town.

Key to Exercise 7

1. We are soldiers of the King of Britain. 2. You are husbandmen of a very fertile island. 3. The poor are often more benevolent than the rich. 4. Be brave, and you will be happier than other men. 5. Many of their own free will remain in the city with the queen. 6. What reward seems most acceptable to them ? 7. Some foreigners remain in our town. 8. Who is this, pray ? This is my friend. 9. Some good people are poor. 10. There are as many opinions as people.

1. Benevolentissimi homines non semper divitissimi sunt. 2. Nihil quam prudentia rarius est. 3. Fortes morti ocius quam turpitudini cedunt. 4. Supplex regina in genibus manet. 5. Acies securis non acuta est. 6. Manus pueri metu tremunt. 7. Quales principes sunt, tales cives sunt. 8. Omnes homines sui benigni judices sunt. 9. Cui dulcior vox est quam tuae sorori ?

Key to Exercise 8

1. The queen walks in the garden with her children. 2. Citizens were contending with citizens in regard to virtue. 3. It is the part of a prudent consul to look after the common weal in prosperity and adversity. 4. I have many friends who will cherish my memory. 5. The soldiers crown the temple with many flowers. 6. I judge him to have been an enemy. 7. Crassus had more than two hundred slaves. 8. The noise availed to a large extent to intimidate our men. 9. It happened to be a time of snow when the enemy were besieging the camp. 10. The sailors contended which of them should steer.

1. Patrem et matrem semper amabimus. 2. Forte cum tuo amico ambulabam. 3. Rex qui civitatem gubernat, civium salutem curare debet. 4. Si mortem timemus, nobis terror semper impendet. 5. Romani urbem obsident, et eam expugnant. 6. Nunquam mortem sed solum infamiam timui. 7. Quid cantabis, mi amice ? 8. Si tot exempla virtutis vos non movent, nihil unquam movebit. 9. P. Africanus, posteaquam bis consul fuerat, L. Cottam in iudicium vocabat. 10. Timor mortis multos terret.

E. A. B.

FRENCH.—IX

Relative Pronouns.—We have already made frequent use of relative pronouns in the sentences quoted as illustrations. They comprise the following forms :—

qui, *who, which ;* que, *whom, which, what ;* quoi, *what ;* dont, *whose, of* or *from whom* or *which ;* and lequel, *who, which, what.*

The last only is variable in relation to number and gender.

To show their relations and uses, let us tabulate them thus :—

Nom. qui, ***who, which.***
Gen. dont, de qui, *of whom, whose* (*dont* alone is used of animals and things).
Dat. à qui, *to whom, which ;* auquel, *to which* (of things, etc.).
Obj. que, *whom* (governed by a verb) ; qui, *whom* (governed by a preposition) ; lequel (of things, etc.).

Lequel, *who, which, what*, is inflected as follows :—

Nom. and		
Obj.	lequel, laquelle	lesquels, lesquelles
Gen.	duquel, de laquelle	desquels, desquelles
Dat.	auquel, à laquelle	auxquels, auxquelles

The pronoun **que**, *whom*, which must be carefully distinguished from the conjunctions **que**, *than*, and **que**, *that*, may be used indifferently with **lequel**, **laquelle**, **lesquels**, **lesquelles**, thus—

les personnes que nous voyons or (lesquelles) nous voyons.	*The persons that we see.*

In the nominative, **qui** alone is employed, and may relate to persons or to things, thus—

les fleurs qui sont dans votre jardin.	*The flowers that are in your garden.*

In the other cases **lequel** may be used alternatively with **qui**, but the latter is preferred when persons are spoken of.

Examples :—

Je connais le monsieur à qui vous venez de parler.	*I know the gentleman to whom you have just spoken.*
l'affaire à laquelle il pense.	*The business that he is thinking of.*
les fleurs dont vous me parlez.	*The flowers of which you speak to me.*

Interrogative Pronouns.—The relative pronouns, with the exception of **dont** (for which **de qui** is used), are employed as interrogatives. As already pointed out, an interrogative is essentially a relative without an expressed antecedent. The following are miscellaneous examples, from which it will be clear that the distinctions between

the forms used for persons and those used for animals and things apply in the same way as to the relatives :—

Qui est là ?	*Who is there ?*
De qui parliez-vous ce matin ?	*Of whom did you speak this morning ?*
Que pensez-vous de cela ?	*What do you think of that ?*
À quoi pensez-vous ?	*What are you thinking of ?*
Quoi de plus aimable que la vertu ?	*What is more amiable than virtue ?*
Lequel avez-vous apporté ?	*Which one have you brought ?*
Lesquelles avons-nous ?	*Which have we ?*

Before a vowel the **e** of **que** is elided thus :—

Qu'avez-vous ?	*What is the matter with you ?*

Indefinite Pronouns.—The indefinite pronouns are the following :—

autrui, *others, other people.*	quelqu'un, *any one, somebody.*
chacun, *each, every one.*	rien, *anything.*
on, *they, people, one.*	rien ne, *nothing.*
personne, *anybody.*	l'un l'autre, *one another.*
personne ne, *no one.*	l'un et l'autre, *both.*
quiconque, *whoever.*	l'un ou l'autre, *either.*
	ni l'un ni l'autre, *neither.*

To these may be added the indefinite adjectives **aucun**, *any, no*, **autre**, *other*, **certains**, *some* (plural), **nul**, *no*, **plusieurs**, *several*, **tel**, *such*, **tout**, *all*, when used without a substantive, in the sense, *any one, no one, another, everything*, etc.

The indefinite pronoun **on** may be rendered *one, we, you, they*, or *people*. It is always used as the subject of a sentence, and, though it expresses the idea of plurality, its verb is always in the singular, thus—

On doit honorer la vertu.	*We should honour virtue.*
On nous apporte de l'argent.	*They bring us money* (or *money is brought to us*).

As in the last example, the active verb of which **on** is the nominative may often be rendered in English by a passive verb, thus :—

On dit que votre épouse est ici.	*It is said that your wife is here.*
On raconte des histoires singulières.	*Strange stories are told.*
On récolte beaucoup de blé en France.	*Much wheat is harvested in France.*

Distinguish between the pronoun **personne** (masculine in gender) and the noun **personne** (feminine), as in :—

Il n'y a personne ici.	*There is no one here.*
C'est une grande personne.	*This is a great person.*

There is a like distinction between the pronoun **rien** and the noun **rien**, as in :—

Je n'ai rien vu.	*I have seen nothing.*
C'est un rien.	*It is a mere nothing.*

Both **personne** and **rien** drop the **ne** in answers to questions not repeating a verb, thus :—

Qu'avez-vous à repondre ? Rien.	*What have you to answer ? Nothing.*
Avez-vous rencontré quelqu'un ? Personne.	*Have you met any one ? Nobody.*

Position of the Pronoun.—Conjunctive pronouns, used as the subject of a sentence, are put before the verb, except in interrogative sentences, thus :—

Vous savez, *you know.* Savez-vous, *do you know ?*

Conjunctive pronouns forming the direct object of sentences are always put immediately in front of the verb, except in imperative sentences used affirmatively, thus :—

Je le sais.	*I know it.*
Ne le bois pas.	*Do not drink it.*
Bois-le.	*Drink it.*

When two conjunctive pronouns are used, one as direct object (objective), the other as indirect object (dative), both are put immediately before the verb, the dative first and the objective next, unless the dative is of the third person, thus :—

Je vous le donne.	*I give it to you.*
Il me le donne.	*He gives it to me.*
Il nous le donne.	*He gives it to us.*

But when the indirect object is in the third person, it is placed after the direct object, as in—

Nous le lui donnons.	*We give it to him.*
Nous le leur donnons.	*We give it to them.*

These rules of precedence apply also to the imperative used negatively, thus—

Ne nous le donnez pas.	*Do not give it to us.*
Ne le lui donnez pas.	*Do not give it to him.*

In the imperative used affirmatively the direct object always precedes the indirect, as in—

Donnez-le nous.	*Give it to us.*
Montrez-le leur.	*Show it to them.*

En and **y** always follow any other pronouns, as in—

Je lui en donne.	*I give him some.*
Il nous y envoie.	*He sends us hither.*
Il nous en a envoyé.	*He has sent some to us here.*

The disjunctive pronouns, on the contrary, regularly come after the verb, as in the following miscellaneous examples :—

Je connais elle et eux.	*I know her and them.*
Je ne crains que lui.	*I fear him alone.*
Je parle à vous et à lui.	*I speak to you and to him.*
Votre frère vous présentera à eux.	*Your brother will introduce you to them.*
Je n'ai pas fait attention à elle.	*I did not notice her.*

VOCABULARY

l'abricot (m.), *the apricot.*	une fois, *one time, once.*
l'ananas (m.), *the pineapple.*	le fromage, *cheese.*
le beurre, *butter.*	hier, *yesterday.*
le courage, *courage.*	le magasin, *store, shop.*
le crayon, *the pencil.*	le matin, *morning.*
écrit, *written.*	mûr, *ripe.*
envoyé, *sent.*	l'oncle, *the uncle.*
l'épicier, *the grocer.*	parler, *to speak.*
faites-vous, *make* or *do* (you).	le sucre, *sugar.*

Exercise 15

1. Les crayons que j'ai sont meilleurs que ceux que vous avez. 2. Vous avez l'un et l'autre. 3. Avez-vous quelques poires mûres? 4. Nous en avons quelques-unes, nous avons aussi beaucoup d'ananas et d'abricots. 5. De quoi voulez-vous parler? 6. L'anglais dont vous parlez est ici. 7. Que faites-vous ce matin? 8. Je sais de qui vous parlez. 9. Pour qui faites-vous cet habit? 10. J'ai vu elle et sa sœur. 11. J'ai écrit à elles et à leur frère. 12. Le roi m'a envoyé à vous. 13. Ce cheval est à moi. 14. Je ne parle qu'à vous. 15. Je ne l'ai vu que deux fois. 16. Elle ne m'a parlé que de son fils. 17. Nous ne savons qui est arrivé. 18. En avez-vous d'autres? 19. J'en ai encore quelques-uns. 20. Je n'ai rien vu.

Exercise 16

1. Which ones has your brother? 2. He has some. 3. Which one have you? 4. Has the grocer plenty of sugar in his shop? 5. He has scarcely any, but he has plenty of butter and cheese. 6. Have you enough tea? 7. I have enough. 8. You are happier than I. 9. Have you more courage than he? 10. He has more courage than I. 11. What are you thinking of? 12. Of what are you speaking to your brother? 13. Is what he tells you true? 14. They have only seen me. 15. Your uncle has sent us to her. 16. They have written only to her. 17. My cousin wrote to you and your sister. 18. My brother sent me to you yesterday. 19. Some one told me that. 20. I have seen neither.

Key to Exercise 13

1. That's all one to me. 2. I know it. 3. What you learn is useful. 4. Do you find what you seek? 5. What I took for the end was only the beginning. 6. It is not the physician that we need, but the priest. 7. This is not what we asked for. 8. We should not have the time, you and I. 9. I do apologise for speaking to you of myself. 10. It was the remembrance of that which came back to me. 11. My garden and that of my brother. 12. My pen and that of my mother. 13. It is I who wished it. 14. Is this house yours or his? 15. Here are my shoes: give me yours. 16. Do you understand what I tell you? 17. He has neither yours nor mine. 18. Has he those of our neighbours? 19. He has not. 20. Have you these or those?

Key to Exercise 14

1. Ce qui est beau est vrai. 2. Mes chandeliers et ceux de votre frère. 3. Mes chandelles et celles de nos voisins. 4. Ma sœur a-t-elle vos fleurs ou celles de ma cousine? 5. Elle n'a ni les miennes ni celles de ma cousine, elle a les siennes. 6. Non, madame, je n'ai pas vos fleurs, j'ai les miennes. 7. J'ai autant de ceux-ci que de ceux-là. 8. N'avez-vous pas plus de verres que d'assiettes? 9. J'ai plus de celles-ci que de ceux-là. 10. Le négociant n'a-t-il plus de fer que d'acier? 11. Il n'a pas autant de celui-ci que de celui-là. 12. Les jardins des italiens sont plus beaux que ceux des anglais. 13. Celui-ci est le plus beau de tous les jardins de la ville. 14. L'aubergiste a-t-il vos chevaux? 15. L'aubergiste n'a ni mes chevaux ni les vôtres. 16. Non, monsieur, je n'ai pas vos plumes, j'ai les miennes. 17. Moi je vous dis cela. 18. C'était moi. 19. Son épouse a-t-elle sa robe ou la vôtre?

E. A. B.

GERMAN.—VI

THE Perfect tenses of werden are formed by the various tenses of sein followed by the Past Part. of werden.

Indicative	*Conjunctive*
Perfect	*Perfect*
ich bin geworden, *I have become.*	ich sei geworden, *I may have become.*
Pluperfect	*Pluperfect*
ich war geworden, *I had become.*	ich wäre geworden, *I might have become.*
Future Perfect	*Future Perfect*
ich werde geworden sein, *I shall have become.*	ich werde geworden sein, *I shall have become.*

Alternative Form of Pluperf. Conj.

ich würde geworden sein, *I should have become.*

The student will realise that the Future Perfect tenses are formed by the Future of sein, i.e. ich werde sein, and that the Past Part. geworden is placed before the Infin. sein.

The Perfect tenses of sein are formed by the tenses of sein and the Past Part. gewesen.

Indicative	*Conjunctive*
Perfect	*Perfect*
ich bin gewesen, *I have been.*	ich sei gewesen, *I may have been.*
Pluperfect	*Pluperfect*
ich war gewesen, *I had been.*	ich wäre gewesen, *I might have been.*
Future Perfect	*Future Perfect*
ich werde gewesen sein, *I shall have been.*	ich werde gewesen sein, *I shall have been.*

Alternative Form of Pluperf. Conj.

ich würde gewesen sein, *I should have been.*

The Perfect tenses of haben are formed by the tenses of haben and the Past Part. gehabt.

Indicative	*Conjunctive*
Perfect	*Perfect*
ich habe gehabt, *I have had.*	ich habe gehabt, *I may have had.*
Pluperfect	*Pluperfect*
ich hatte gehabt, *I had had.*	ich hätte gehabt, *I might have had.*

Future Perfect	*Future Perfect*
ich werde gehabt haben, *I shall have had.*	ich werde gehabt haben, *I shall have had.*

Alternative Form of Pluperf. Conj.

ich würde gehabt haben, *I should have had.*

The student should note that in the Fut. Perf. tenses of sein and haben the Past Part. precedes the Infin. just as in werden.

Conjugation of Verbs.—In German there are two clearly defined conjugations, the Weak and the Strong. They differ in the following respects: the weak verbs form the first pers. of the Past Ind. tense by adding **te** or **ete,** and their Past Part. by the prefix **ge** and the ending **t** or **et**; the strong verbs form the first pers. Past Ind. tense by changing the stem vowel without adding any termination, and their Past Part. by the addition of the prefix **ge** and the ending **en.**

We have the same in English. For example, leben, lebte, gelebt, *live, lived, lived,* is weak; whereas geben, gab, gegeben, *give, gave, given,* is strong.

We will now give the conjugation of a weak and of a strong verb side by side, so that the student may clearly see their points of resemblance and of difference.

For the present we shall confine ourselves to the active voice, and, as before, we shall give only the first pers. of those tenses which are formed by means of auxiliaries and the Infin. or Past Part. of the verbs we are conjugating.

Weak verb **kaufen**, *to buy.* Strong verb **singen** (zingən), *to sing.*

Present Infinitive

kauf-en, *to buy.*	sing-**en**, *to sing.*

Present Participle

kauf-**end**, *buying.*	sing-**end**, *singing.*

Past Participle

gekauf-**t** (gəkowft), *bought.*	**ge**sung-**en** (gəzungən), *sung.*

Perfect Infinitive

gekauft haben, *to have bought.*	gesungen haben, *to have sung.*

Indicative

Present: I buy, etc.; I sing, etc.

ich kauf-**e**	ich sing-**e**
du kauf-**st**	du sing-**st**
er kauf-**t**	er sing-**t**
wir kauf-**en**	wir sing-**en**
ihr kauf-**t**	ihr sing-**t**
Sie kauf-**en**	Sie sing-**en**
sie kauf-**en**	sie sing-**en**

Preterite: I bought, etc.; I sang, etc.

ich kauf-**te**	ich sang (zank)
du kauf-**test**	du sang-**st** (zangst)
er kauf-**te**	er sang
wir kauf-**ten**	wir sang-**en**
ihr kauf-**tet**	ihr sang-**t**
Sie kauf-**ten**	Sie sang-**en**
sie kauf-**ten**	sie sang-**en**

Future: I shall buy, etc.; I shall sing, etc.

ich werde kaufen	ich werde singen

Perfect: I have bought, etc.; I have sung, etc.

ich habe gekauft	ich habe gesungen

Pluperfect: I had bought, etc.; I had sung, etc.

ich hatte gekauft	ich hatte gesungen

Future Perfect: I shall have bought, etc.; I shall have sung, etc.

ich werde gekauft haben	ich werde gesungen haben

Conjunctive

Present: I may buy, etc.; I may sing, etc.

ich kauf-**e**	ich sing-**e**
du kauf-**est**	du sing-**est**
er kauf-**e**	er sing-**e**
wir kauf-**en**	wir sing-**en**
ihr kauf-**et**	ihr sing-**et**
Sie kauf-**en**	Sie sing-**en**
sie kauf-**en**	sie sing-**en**

Past: I might buy, etc.; I might sing, etc.

ich kauf-**te**	ich säng-**e** (seng)
du kauf-**test**	du säng-**est**
er kauf-**te**	er säng-**e**
wir kauf-**ten**	wir säng-**en**
ihr kauf-**tet**	ihr säng-**et**
Sie kauf-**ten**	Sie säng-**en**
sie kauf- **ten**	sie säng-**en**

Future: I shall buy, etc.; I shall sing, etc.

ich werde kaufen	ich werde singen

Alternative Form of Past: I should buy, etc.; I should sing, etc.

ich würde kaufen	ich würde singen

Imperative

Buy (thou), *etc.; sing* (thou), *etc.*

kaufe	singe
kaufe er	singe er
kaufen wir	singen wir
kauft	singt
kaufen Sie	singen Sie
kaufen sie	singen sie

Conjunctive

Perfect: I may have bought, etc.; I may have sung, etc.

ich habe gekauft	ich habe gesungen

Pluperfect: I might have bought, etc.; I might have sung, etc.

ich hätte gekauft	ich hätte gesungen

Future Perfect: I shall have bought; I shall have sung.

ich werde gekauft haben	ich werde gesungen haben

Alternative of Pluperfect: I should have bought, etc.; I should have sung, etc.

ich würde gekauft haben	ich würde gesungen haben.

The student will notice that the terminations in the simple tenses only differ in the Preterite, where the weak verb has **te**, etc., and the strong verb has the same terminations as in the Pres., except that the 1st and 3rd pers. sing. have no termination at all in the Indicative.

Further, it is worth noting that the terminations in the Conj. differ from those of the Ind. only in the following points: the 2nd pers. sing. and plur. have **est** and **et** in the former where we find **st** and **t** in the latter, and the 3rd pers. sing. Pres. Conj. has **e** where the Ind. has **t**.

In strong verbs the Past Conj. is formed from the Past Ind. by the addition of the terminations of the Pres. Conj. and the modification of the stem vowel where this is possible.

Exercise 18

1. Give the 1st pers. sing. and plur. of the Pres. Ind. Pret. and Fut. of the following weak verbs:—leben (laybən), *to live;* legen (laygən), *to lay;* schicken (shickən), *to send;* lieben (leebən), *to love;* neigen (nygən), *to bow or bend;* zeigen (tsygən), *to show;* kochen (kokən), *to cook;* führen (fürən), *to lead.*

2. Give the 2nd and 3rd pers. sing. of the Pres. Conj., 3rd pers. plur. Past Conj. (both forms) and 3rd pers. sing. Fut. Conj. of the same verbs.

3. Give the comparative and superlative of the following adjectives:—grosz, gut, klein, rot (roht), *red;* schön, häszlich (hesslich), *ugly;* zahm, hohl (hohl), *hollow;* lang (lank), *long;* hoch, kurz (kurts), *short;* billig (billig), *cheap;* teuer (toyər), *dear;* mächtig (mechtig), *strong, mighty;* dünn (dünn), *thin;* dick (dick), *thick, fat;* süsz (züss), *sweet.*

The following points about the conjugation of verbs should be carefully studied:—

A. The Infinitive always ends in **n** and almost always in **en**. The verbs that do not end in **en** are sein, tun (toon), *to do*, and such whose stem consists of more than one syllable and ends in l or r, e.g. wandeln, *to walk*, and wandern, *to wander*.

B. The 1st pers. sing. Pres. Ind. and Conj. are the same and are formed by adding **e** to the stem. The 1st pers. sing. in the Past Ind. and Conj. of weak verbs ends in te or ete.

C. The 3rd. pers. sing. of the Pres. Ind. ends in **t** or **et**. In all other simple tenses the 3rd pers. is the same as the 1st.

D. The ending of all 2nd pers. sing. (except in the Imperative) is **st** or **est**; of all 1st and 3rd plur. (including the polite form of address, which is the same as the 3rd plur.) is **en** or **n**; of all 2nd pers. plur. **et** or **t**.

The retention of the vowel **e** in the endings **est**, **et** is a matter of euphony, i.e. the **e** is always retained when it sounds better to use the fuller form. Thus all verbs whose stem ends in d or t keep the fuller forms: ich rede (rayde), *I speak;* du redest, er redet, etc.

Verbs whose stem ends in a sibilant (s, z, sz) retain the **e** in the 2nd pers. sing., e.g. du tanzest (tantsəst), *thou dancest*, as do such verbs whose stem ends in a double consonant which would be awkward to pronounce without the **e**, e.g. du atmest (ahtməst), *thou breathest;* du öffnest (öffnəst), *thou openest*.

Verbs ending in **eln**, **ern** drop the **e** of the stem in the 1st pers. sing. Pres. Ind. and Conj., but in all other persons drop the **e** of the termination, e.g. ich wandre, wir wandern.

E. The Pres. Part. always ends in **end**.

F. Verbs of foreign origin ending in **ieren** and verbs beginning with an unaccented prefix do not have the prefix **ge** in the Past. Part; thus the Past Part. of marschiéren (marsheérən), *to march*, is marschiért, and ot erzählen (ayrtsaylən), *to tell* (a story), is erzählt.

The student will have noticed that the above rules do not apply to the verb sein, which is quite irregular.

VOCABULARY

er kam (kahm), *he came.*
Dio'genes (dioh'genəs), *Diogenes.*
Nähe (nayhə), w.f., *neighbourhood.*
neben (naybən), prep. gov. dat., *beside.*
er sasz (zahss), *he sat.*
Philosoph' (feelohzohf'), w.m., *philosopher.*
Angst (angst), s.f.2, *fear.*
entgeg'nen (entgay'gnən), *to reply.*
Ding (ding), s.m.2, *thing.*
sich freuen (froyən), reflex., *to be glad.*
helfen (helfən), *to help.*
du willst (villst), *thou wilt.*
geh, imperat. of gehen (gayhən), *to go.*
Sonne (zonnə), w.f., *the sun.*
über (übər), prep., *above.*
Bedürfnis (bədürfnis), *need.*
zufrie'den (tsoofree'dən), *contented.*
ganz (gants), *whole.*
genügen (genügən), *to be sufficient*, gov. dat.
streben (shtraybən), *to strive.*
Korinth (korint), *Corinth.*
er fand (fant), *he found.*
Wald (valt), s.m.3, *forest.*
Tonne (tonnə), w.f., *cask, barrel.*
sich sonnen (zonnən), reflex., *to sun oneself.*
Hund (hunt), s.m.2, *dog.*
vor (fohr), prep., *before.*
ich sehe (zayhə), *I see.*
fehlen (faylən), *to be wanting.*
Gele'genheit (gaylay'gənhyt), w.f., *occasion, opportunity.*
verlang'en (fayrlang'ən), *to ask, demand.*
aus (owss), prep., *out of.*
weit (vyt), *far.*
menschlich (menshlich), *human.*
er stand (shtant), *he stood.*
er fuhr (foor) fort (fort), *he continued.*
Mantel (mantəl), s.m.1, *mantle.*
Reich (rych), s.n.2, *kingdom.*
fortwäh'rend (fortvay'rənt), *continually.*
vergrös'sern (fayrgrös'sern), *to enlarge.*

Exercise 19

Alexander und Diogenes.

Alexander der Große kam einmal nach[1] Korinth, und besuchte dort Diogenes. Er fand ihn in[2] der Nähe eines Waldes wo[3] er neben seiner Tonne saß und sich[4] sonnte. Alexander sagte ihm, „Ich bin der große König Alexander." „Und ich" antwortete der Philosoph, „bin der Hund Diogenes." „Hast du nicht Angst vor mir?" fragte der König. „Bist du ein guter oder ein schlechter Mensch?" entgegegnete Diogenes. „Ich bin gut," sagte Alexander. „Wer würde vor einem guten Menschen Angst haben?" antwortete der Philosoph. Nach[5] einer längeren[6] Unterhaltung sagte der große König, „Ich sehe daß dir viele Dinge fehlen[7]; ich würde mich freuen[8] eine Gelegenheit zu haben dir zu helfen. Verlange von mir was du willst." Darauf antwortete Diogenes, „Ich bitte dich, gehe mir aus der Sonne." Alexander War höchst[10] erstaunt einen Mann zu sehen der so weit über[11] jedem menschlichen Bedürfnis stand. Diogenes fuhr fort, „Wer von uns beiden ist der glücklichere, derjenige der mit seinem Mantel und seiner Tonne zufrieden[12] ist, oder derjenige dem ein ganzes Reich nicht genügt und der fortwährend danach[13] strebt es zu vergrößern?[14]"

NOTES:—

(1) nach is always used in connection with motion towards a place in the sense of to. It always governs the dat. (2) in gov. the dat. here because it indicates rest, not motion. (3) wo: used here as a conjunctive adverb. (4) sich is the reflexive pron. 3rd pers. sing. and plur. (5) nach here refers to time and means after. (6) länger: the comparative is used here in the sense of rather long. (7) fehlen is used impersonally here, and in this sense governs the dat. of the pers. (8) mich freuen: for the reflexive pron. of the 2nd and 3rd pers. the acc. of the pers. pron. is used. (9) mir: this is a kind of ethic dat. or dat. of advantage; it means for me, or for my sake. (10) höchst: the uninflected form of the superl. is used here adverbially. (11) über governs the dat. when it indicates rest, not motion. (12) zufrieden ist: as zufrieden is that part of the predicate most closely connected with the verb, and as the finite verb must go to the end of the clause which is a dependent clause, zufrieden is also put at the end immediately before the finite verb. (13) danach is literally thereafter; when a prep. governs the 3rd pers. pron. neut., instead of putting the pron. after the prep., the adverb da is prefixed to it, and when the prep. begins with a vowel, the letter r is placed between da and the prep., e.g. thereon, daran, i.e. on it. (14) vergrößern: this infinitive phrase is in apposition to the pron.; it is implied in danach.

Exercise 20

1. We came to Corinth and visited a man there. 2. This house is in the neighbourhood of a forest, where there are many big trees. 3. We sent a little book to that ugly woman who was sitting beside the fat child. 4. I see that you had a long conversation with the sister of that philosopher. 5. I heard that she had been ill, and I am glad that she was sitting in the garden and was sunning herself. 6. This is not sufficient for you, I will send you more. 7. They were highly astonished because he came. 8. He is happier than she. 9. He is not satisfied with his son. 10. We should be glad to play in the garden. 11. Which of these two men is the better?

Key to Exercise 11

There was once a king. He was old and dissatisfied. He went to a hermit and asked him: "How can I become happy?" The hermit answered, "Thou must wear the shirt of a happy man." The king thereupon said to his minister, "Thou must find a happy man, and I will then wear his shirt." The minister went into the town, and he asked every man, "Art thou happy?" But every man answered, "No." Then he went into the country and saw there a shepherd. He asked him, "Art thou happy?" The shepherd answered, "Yes, why not?" The minister took (brought) the shepherd to the king. The latter said to him, "Give me thy shirt." But thereupon the shepherd answered, "I have no shirt!"

Key to Exercise 12

Er war alt und unzufrieden. 2. Er ging zu einem Eremiten. 3. Er sagte, "Wie kann ich glücklich werden?" 4. Er sagte, "Du muszt das Hemd eines glücklichen Menschen tragen." 5. Er ging in die Stadt, und dann aufs Land. 6. Der Hirte war glücklich. 7. Der Minister brachte ihn zu dem Konig. 8. Nein der Hirte hatte kein Hemd.

Key to Exercise 13

There was an old king, his heart was heavy, his head was grey; the poor old king, he took a young wife.

There was a beautiful page, fair was his head, light was his heart (literally, mind); he bore the silken train of the young queen. Dost thou know the old song? It sounds so sweet, it sounds so sad. They both had to die, they loved one another far too dearly (literally, they held one another much too dear).

Key to Exercise 14

1. Er war alt. 2. Es war schwer. 3. Es war grau. 4. Er nahm eine junge Frau. 5. Er war schön, sein Haupt war blond und sein Sinn war leicht. 6. Er trug die Schleppe der jungen Königin. 7. Sie war seiden. 8. Sie hatten sich viel zu lieb.

Key to Exercise 14a

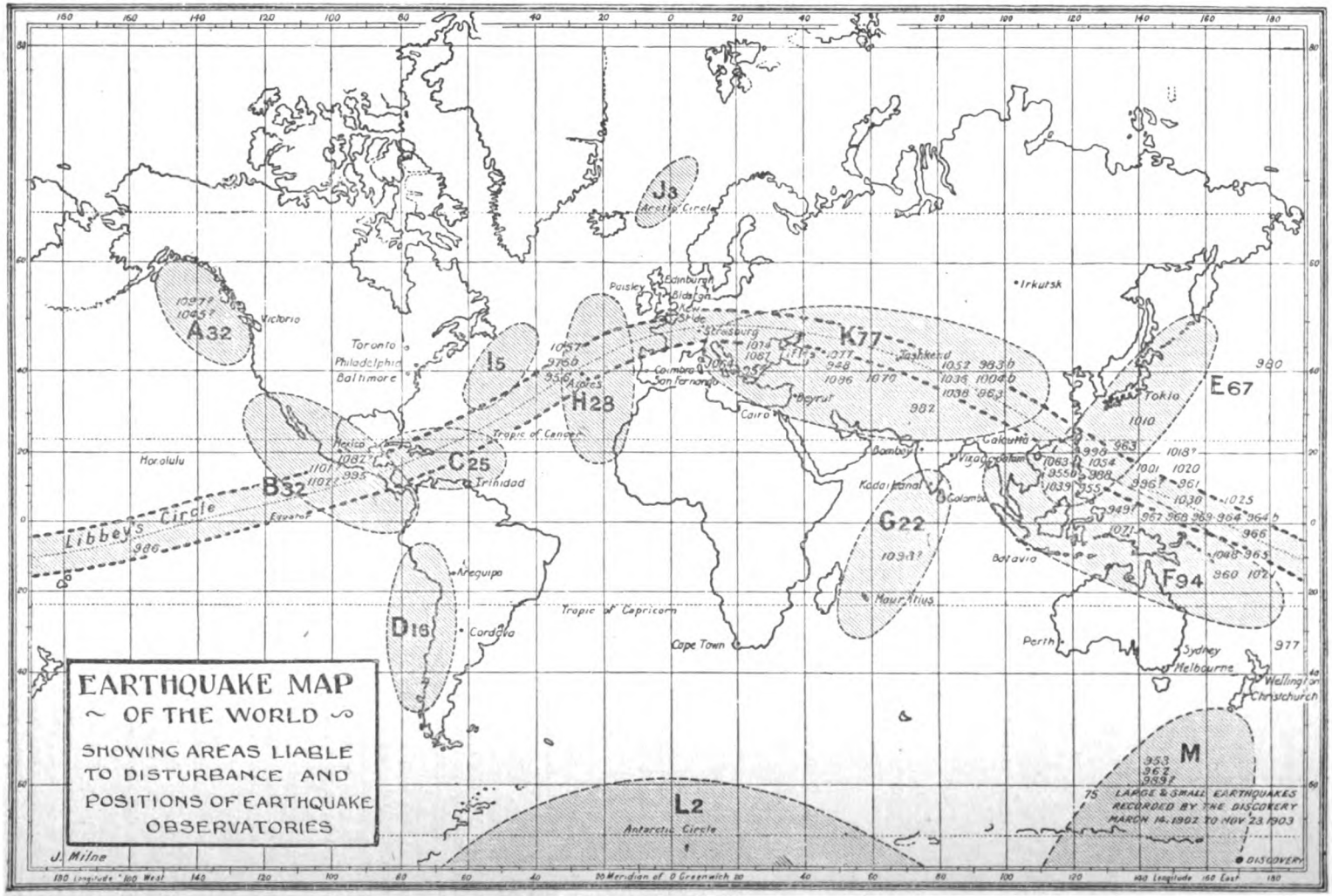
1. Mein Herz ist schwer. 2. Der arme König war alt. 3. Seine Frau war jung. 4. Sie waren ein schöner junger Page. 5. Sie hatte eine seidene Schleppe. 6. Ihre Lieder sind alt und süsz. 7. Es klingt trübe. 8. Kennst du diese trüben Lieder? 9. Sein Haupt war grau aber ihr Haupt war blond.

Key to Exercise 15

1. Here is that book which you were looking for yesterday. 2. The woman whose daughter was here is upstairs. 3. The man who is fetching your boots is the same to whom I gave the money yesterday. 4. We do not hear the noise that you hear. 5. They looked for the garden in which the apples are. 6. The gardener whose house I bought is not here. 7. There in that street are the houses in which we live. 8. In those gardens the girls work whose letters we looked for.

9. Hier ist das Wasser welches (or das) Sie suchten. 10. Dort ist der Mann dessen Schwestern in jener Stadt wohnen. 11. Der Diener der (or welcher) meine Stiefel holte ist nicht hier. 12. Dort ist jener Gepäckträger dem er das Geld gab. 13. Er holt die Briefe die (or welche) Sie suchen. 14. Wo ist der Hut den (or welchen) sie gestern kaufte? 15. Derjenige Hut den sie sucht ist unten. 16. Diejenigen Männer denen er die Bücher gab wohnen hier. 17. Die Frauen deren Kinder hier waren sind oben.

M. A. L.



Earthquake districts are indicated by A, B, C, D, etc. The numerals following these letters indicate the number of large earthquakes in each area over a period of eight years. Most of the earthquake areas, it will be noticed, are contained in the band known as Libbey's Circle.

Continued from Vol. I., page 492.

GEOGRAPHY:

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LAND FORMS AND THEIR ORIGIN.—II

WHEN in the Polar regions a glacier descends a valley until it reaches the sea, it is pushed on into the water and the end breaks off and floats. This floating mass of ice is called an iceberg.

As the specific gravity of ice is about nine-tenths that of water, only about one-tenth of the iceberg is actually visible above the surface. As the iceberg gradually travels into warmer latitudes, it melts away, and any rock that had been frozen into it will be deposited on the ocean bed. As those icebergs formed in the Antarctic region are met with of a height of six or seven hundred feet, the actual thickness of the glacier from which they have been broken off must have been some 6,000 feet! Icebergs have been known to transport polar animals which had happened to be on the glacier when it broke to form the berg. Icebergs are seldom found north of latitude 35° S. in the Antarctic regions, or south of latitude 40° N. in the Arctic regions. The melting away of these huge masses of ice is supposed to have a great effect in forming the fogs that are so common just about the shores of Newfoundland.

Beneath the Earth's Crust

Avalanches are masses of snow which roll down the sides of mountain slopes into the valleys beneath, often with very destructive effect. Such snow may roll down like a snowball and become larger as it descends, or it may simply slide down under pressure of its own weight. A glacial avalanche is a mass of frozen snow and ice which, as the snow melts in the spring, becomes detached from a glacier.

There is no doubt that the interior of the Earth is hotter than the crust. As we descend a mine the temperature rises on an average roughly one degree Fahr. for every 64 feet of descent. It is noticed that the temperature of deep artesian well waters and hot springs is higher than that of surface springs. The hot springs of Bath are at a temperature of about 120° Fahr.

Though the interior of the Earth is thus hotter than the surface (it has been calculated to be not less than 2,200° Fahr.), it must not be supposed that it is in a molten or liquid condition. The enormous pressure exercised by the crust causes it to maintain the solid state, and only if that pressure were removed would it at once become liquid. As this enormously hot mass contains a large quantity of water which has percolated downwards through minute cracks and crevices, it is only necessary for the pressure to be eased for it to expand with violence.

Origin of Volcanoes

Now, the volcanoes of the Earth are, very roughly speaking, disposed along shore-lines, which is probably due to the fact that the present coast-lines of the Earth's surface have been determined by earth folds (*see* p. 297, Vol. I.). These folds are sources of weakness in the Earth's crust, and if at any point the pressure within is able to overcome the weight of the crust, a volcano is likely to be formed.

Volcanoes are therefore holes or cracks in the Earth's crust, and from these are thrown out various materials, generally at a high temperature and with great violence.

Typically, a volcano is a mountain of conical form which discharges steam and other gases, lava, ashes and rock fragments through a hole or cup-shaped orifice known as the crater, or, as in the case of Souffrière, through fissures in the mountain's side.

Another fairly common type of volcano, known as the effusive, emits floods of lava with little or no explosive violence. The best examples of effusive volcanoes are found in the Sandwich Islands, such as Kilauea. In this volcano the crater is a huge flat-bottomed pit over two miles across with vertical sides some 800 feet high, and

in the centre a "lake of fire," or molten lava.

Volcanoes may be either active, such as is Stromboli, in the Lipari Islands, near Italy, which is constantly in a state of eruption, or Vesuvius, which is eruptive at more or less regular intervals, or they may be extinct, when activity appears to have ceased. Occasionally a volcano thought to be extinct is shown to be really only dormant, and breaks out into activity after a period of rest which has lasted for many years.

Earthquakes

The liquid material emitted by a volcano is known as lava, and has a varying appearance, due to differing chemical composition. The gaseous materials, besides steam, may include sulphur dioxide and hydrochloric-acid gas. Solid matter consists largely of ashes with rock fragments broken off the sides of the vent. In the great eruption of Krakatoa, one of the Sandwich Isles, in the year 1883, the finest ashes emitted were carried round the earth by the wind no less than twice, and were the cause of the brilliant sunsets which were noticed all over the world at that time.

The volcanoes of the world are, roughly speaking, disposed in more or less linear fashion on the main shore-lines of the continents. Around the shores of the Pacific Ocean this linear arrangement is particularly well marked. There is an almost continuous line of them along the shores of South and North America. Then they pass by way of the Kurile Islands and Japan down the Asiatic coast as far as the Malay Archipelago. Round the Atlantic the distribution is not quite so well marked and obvious, but a study of the map will show a certain degree of uniformity, which is also noticeable around the shores of the Indian Ocean.

These are another form of volcanic activity, but have not the violence of volcanoes; they are, in fact, evidence of a decline in volcanic action. A geyser is a fountain of hot water, and is intermittently active; in many cases the action is regular in its periodicity, the most extraordinary example used to be one of the geysers in the Yellowstone Park, which emitted a fountain about every hour with remarkable regularity. Geysers are principally found in three regions of the earth, namely Iceland, New Zealand and the Yellowstone Park region of the United States of America. In Iceland are also found mud volcanoes, where a geyser is active through beds of clay. Occasionally only gas is emitted from a vent in the earth; this is known as a *solfatara*.

Earthquakes originate beneath the surface of the Earth, and are propagated through the Earth's crust as a disturbance, gradually decreasing as the distance from the source increases. Their causes are even yet not fully understood, but they are believed either to originate in volcanic action, or to be caused by slipping movements of the great masses of rock in the Earth's crust. The point where the disturbance actually takes place is known as the *seismic centre*, and though the effect of an earthquake immediately above this may be tremendously severe, the actual movement of the ground is surprisingly small, rarely exceeding two inches on hard rock.

There seems to be a tendency for earthquakes to originate under the bottom of the sea, near to continents or large islands; this may be connected with the fact that, like volcanoes, they are due to weaknesses of the Earth's crust. In most cases such an earthquake is accompanied by a huge wave of water which often has a very destructive effect.

Libbey's Circle

Earthquakes, generally speaking, are confined to certain definite areas, most of which fall within a band running round the centre of the earth known as Libbey's Circle (*see* map in Vol. II., page 38).

The most disastrous earthquake ever recorded is that which took place in Sicily in the year 1908, and which is known as the Messina earthquake. In this terrible catastrophe no fewer than 300,000 lives were lost, and the two towns of Reggio and Messina were very nearly completely destroyed. The actual earthquake shock lasted 37 seconds, and the whole province of Calabria was wrecked. A destructive sea-wave, some 25 feet in height, was formed, and swept over the coasts on both sides of the Straits of Messina, which were actually found to be six feet deeper after the earthquake.

By means of very delicate instruments known as seismographs a great deal of information has been collected regarding the place of origin and the effects of earthquakes, but a description of these would be too lengthy to enter upon in this place. It is of interest to note that in the case of the Messina earthquake noticed above the actual origin was calculated and the time determined by observations of a scientist in Japan nearly 10,000 miles away, the actual earth tremor having taken nearly twelve minutes to travel the distance.

The land surface of the Earth, as has already been noticed, can be divided roughly, according to its height, into mountains, plateaux and plains. We will now consider these different forms in detail.

Mountain Ranges

Typical mountain ranges present certain features which are general. They consist, not of a single ridge, but of a series of more or less parallel ranges separated by longitudinal depressions. The central range is generally the highest, and each side the subordinate ranges are of successively less elevation, gradually dying down into foothills and the general surface of the plain. Often the highest peaks are devoid of vegetation and and metamorphosis of the rocks of which the range is composed.

It is obvious that the age of a mountain range must be less than that of the newest beds of rocks which compose the chain, and in this way we can tell that the chief mountain ranges of the Earth were formed in Tertiary times, proving them to be comparatively recent, although in some of them traces of earlier earth movements have been detected.

Another method by which mountains have been formed is by the raising of a portion of the Earth's crust which is bounded by parallel fissures. An example of this method of mountain formation is shown in the Vosges Mountains in France. Often a range of low

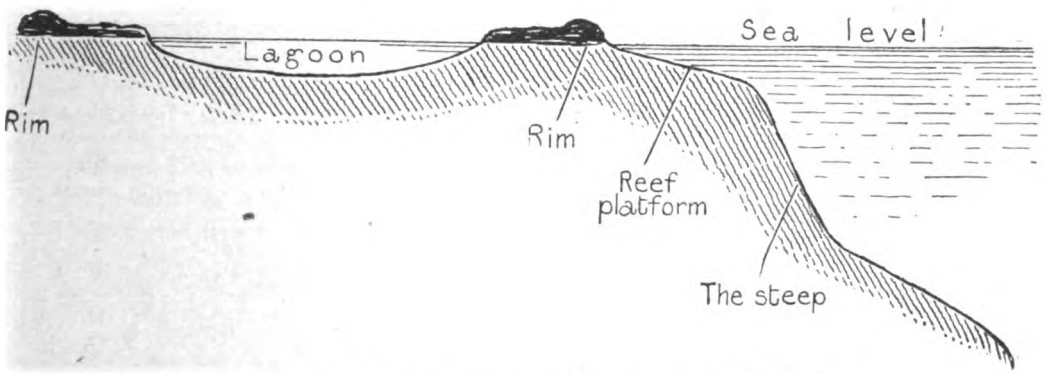


Fig. 27.—Diagram showing a cross section of a typical Coral Atoll.

are rocky, and on these are found the snowfields and glaciers, which latter may descend into the forest zone on the lower slopes before they melt away. Each altitude has its characteristic vegetation, but this subject will be dealt with later on. Besides the longitudinal valleys we find transverse valleys cutting through the intervening ridges, and through these we often find the passes and roads which render communication possible between the two sides of the range.

The rocks of which a mountain range are composed are often vertical or, at any rate, highly inclined, and when examined carefully by the geologist these are found to have been forced into folds. This structure is due to compression at the sides of the range, due to the great pressure exercised by the Earth's crust. This pressure may have been caused in many ways, but it can easily be understood that the accumulation of vast masses of material from high lands on to the plains brought down by river action is sufficient to exert enormous lateral pressure along lines of weakness and also produces "faulting" hills or a plateau is found to be the roots of an old mountain chain which has been eroded by the action of a river and the weather. These may have been at one time lofty mountain ranges, but have been worn away by the processes of denudation described earlier.

Plains and Islands

As a rule, the term plain is used to signify such flat surfaces of the Earth as are found in the lowlands, though in N. America the great plains rise imperceptibly almost from sea level to about 6,000 feet. Plains have been formed in two ways, one by denudation or wearing away of higher ground, or else by the accumulation of deposits by different agencies, such as river action, glacial deposits, or wind-blown matter. Most plains are of mixed origin.

As examples of the different kinds of plains we may note (i) Aeolian plains, covered with blown sand in the form of dunes. These are common in all desert regions, such as the Sahara. (ii) Fluvial plains, due partly to the

erosive action of rivers and partly to accumulation, such as the plain of the lower part of the Rhine. (iii) Marine plains, these are old ocean floors now above sea level. The marine plain round the Gulf of Mexico is an example of this type.

An island is a piece of land entirely surrounded by water. Thus, in a sense, all the continents are islands, and the largest islands are consequently the Old World, North and South America, and Australia.

Apart from such consideration, islands may be formed in various ways, such as the gradual submerging of a mountain range. This process would form a chain of islands, and was the method of formation of the Lesser Antilles, in the West Indies. Such islands are called relic islands.

Relic Islands

Possibly the greater number of islands of any considerable size are relic islands of which some have been denuded more than others, and have thus lost more of their originally mountainous characters.

Other islands have been formed by the gradual rising above the waves of material from the interior of the Earth. Coral islands have been formed by the action of the reef-building coral polyp. Exactly how such islands have occurred is a matter of controversy even now.

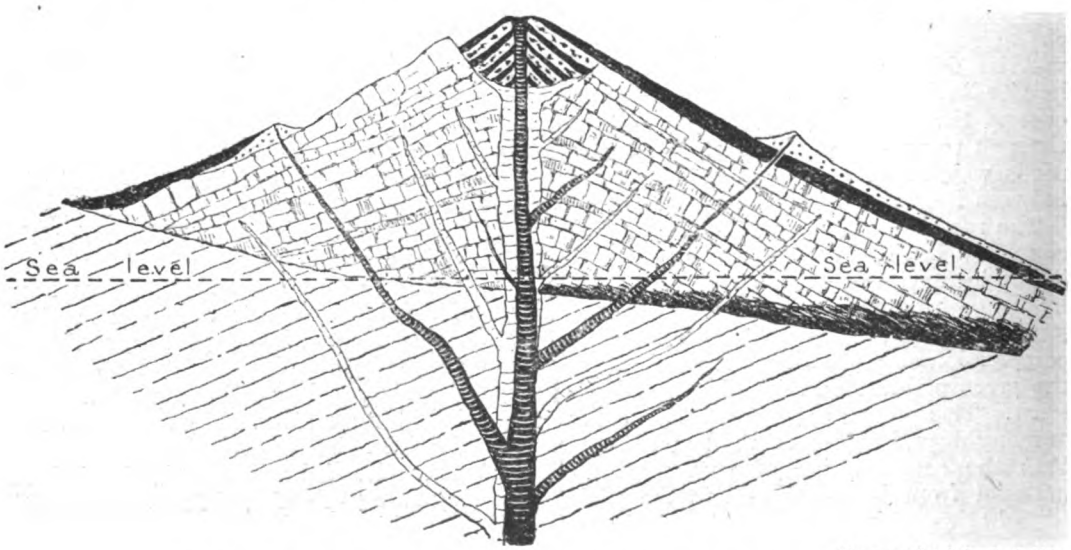
According to Darwin, coral reefs afford evidence of the subsidence of the ground where they occur. The reef-building coral cannot live in water below a depth of about 120 feet, and at about this depth it must have commenced to work and have built upwards at a rate just about the same as the land was subsiding.

At first a mere fringing coral reef would be found around the island. If the island still continues to sink, the fringing reef will descend with it, but the coral polyps still continue to build and raise the reef to the surface as it becomes gradually submerged.

Coral Reefs

Eventually this process gives rise to a barrier reef in section, that is, a tiny island surrounded by a ring of coral. The last stage is the formation of the true coral island, or atoll, as is shown in Fig. 27, where the land has all disappeared beneath the surface of the sea and a ring of coral only remains above the surface.

Although it has been said that the coral polyp "builds" an island in this way, the expression is not, strictly speaking, true. The polyp simply lives its life in the surroundings best suited to it, and when it dies the calcareous, or limy, skeleton which is left forms by its accumulation the limestone reef which we call a coral reef. For more details, and Darwin's proofs of this fascinating theory, his book, called "A Naturalist's Voyage Round the World," should be read. To the student of geography no more interesting book could be recommended, and the formation of coral reefs is developed therein in considerable detail, but his explanation is by no means universally accepted. C. J. S.



From a sketch by J. Geikie.

Fig. 28.—Diagram showing the structure of a typical volcanic cone.

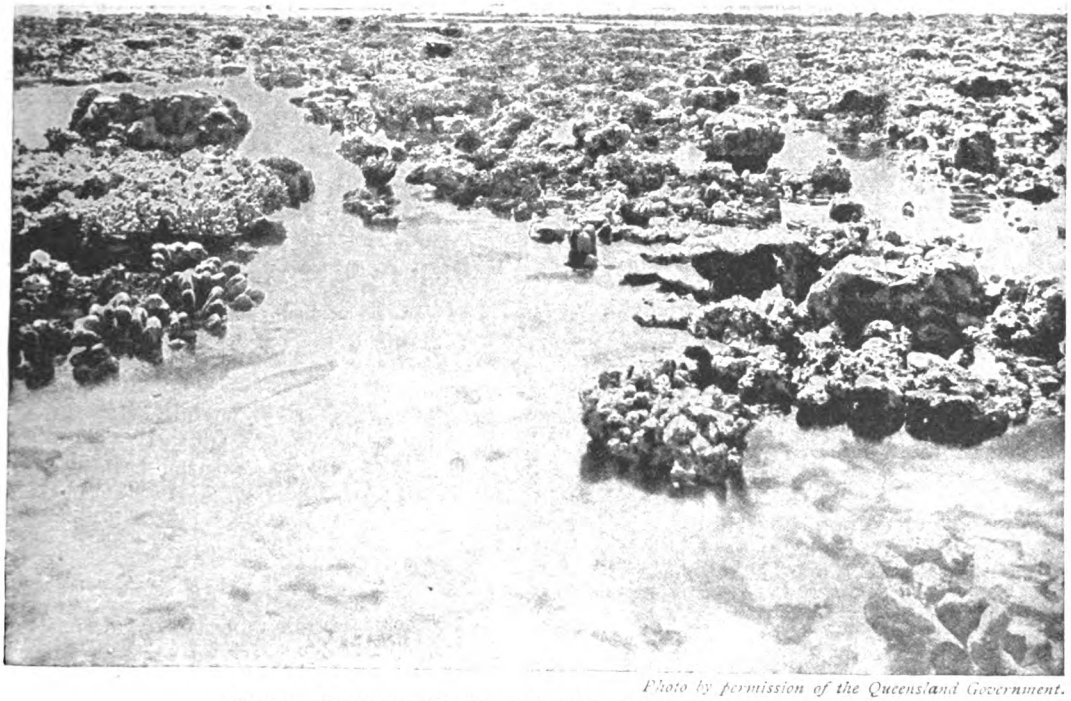


Photo by permission of the Queensland Government.

OUTER BARRIER REEF, OFF THE AUSTRALIAN COAST.

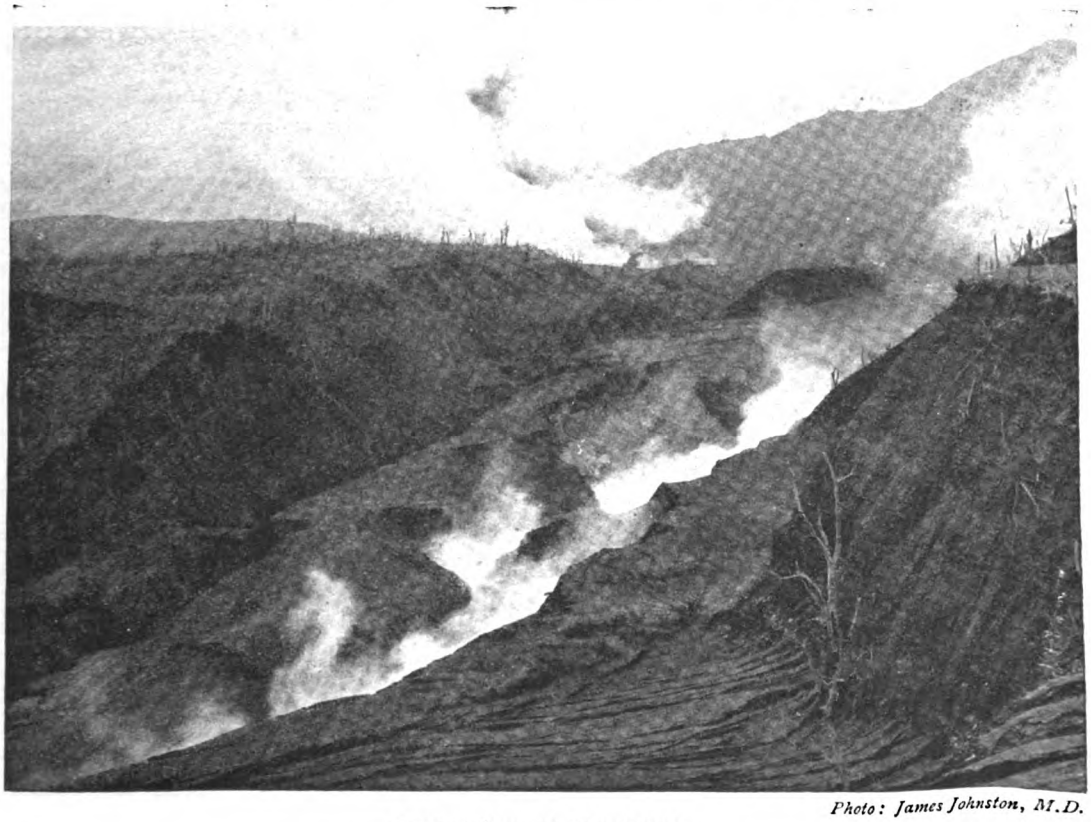


Photo: James Johnston, M.D.

SOUFFRIÈRE IN ERUPTION.

Clouds of smoke are shown issuing from the great fissure in the mountain's side. Souffrière is a volcano on the Island of St. Vincent, West Indies.

Continued from Vol. I., page 500.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.
(M. A. Lewenz, M.A.[Lond.]).

ARITHMETIC.—IX

79. The value of the recurring decimal $\cdot\dot{9}$ is found by § 77 to be $\frac{9}{9}$ or 1.

Now the difference between 1 and ·9 is ·1; and the difference between 1 and ·99 is ·01; and the difference between 1 and ·999 is ·001, and so on. Hence we see that to however many places we take the recurring decimal $\cdot\dot{9}$, its value never *actually* = 1, but by taking it far enough we may make it differ from 1 by as small a quantity as we please, and therefore we say that $\cdot\dot{9}$ is equivalent to 1. In the same way a vulgar fraction may be said to be equivalent to a recurring decimal.

80. Addition and subtraction of recurring decimals.

To add recurring decimals we place them below one another, as we do with ordinary decimals, taking care to put the decimal points one below the other so that tenths are added to tenths, hundredths to hundredths, and so on. The periods must be repeated a sufficient number of times to show the recurrence in the sum.

(1) Add together $\cdot23\dot{4}$ and $\cdot0\dot{1}\dot{7}$.

$$\begin{array}{r} \cdot2344444\ldots \\ \cdot0171717\ldots \\ \hline \cdot2516161\ldots \end{array}$$

The sum is obviously $\cdot25\dot{1}\dot{6}$.

Subtraction of recurring decimals is treated similarly.

(2) To find the difference between $5\cdot\dot{2}$ and $3\cdot0\dot{4}9\dot{1}$.

$$\begin{array}{r|l} 5\cdot2222 & 22 \\ 3\cdot0491 & 49 \\ \hline 2\cdot1\dot{7}3\dot{0} & \end{array}$$

The difference = $2\cdot1\dot{7}3\dot{0}$.

81. In order to **multiply** and **divide** recurring decimals by one another we must first reduce them to equivalent vulgar fractions, perform the operations of multiplication or division, and then express the product or quotient as the case may be, as a recurring decimal.

Exercise 27

Reduce the following vulgar fractions to recurring decimals.

(1) $\frac{2}{11}$, $\frac{5}{9}$, $\frac{4}{13}$, $\frac{1}{7}$, $\frac{3}{13}$.

(2) $\frac{13}{30}$, $\frac{286}{495}$, $2\frac{815}{999}$, $24\frac{83}{577}$.

Find the vulgar fractions in their lowest terms equivalent to the following recurring decimals:—

(3) $\cdot\dot{7}$, $\cdot0\dot{4}$, $\cdot0\dot{2}\dot{7}$, $\cdot1\dot{4}\dot{3}$, $\cdot\dot{0}12\dot{6}$, $\cdot54\dot{3}1\dot{2}$.

(4) $\cdot\dot{3}031300\dot{6}$, $\cdot1\dot{4}53\dot{9}$, $\cdot14\dot{5}3\dot{9}$, $\cdot145\dot{3}\dot{9}$, $\cdot1453\dot{9}$.

(5) $\cdot0037\dot{1}8\dot{2}$, $\cdot300\dot{7}5\dot{1}$, $\cdot8\dot{7}5\dot{1}\dot{4}\dot{3}$.

Exercise 28

Find the value correct to 6 places of decimals of

(1) $3\cdot2\dot{0}9 + 1\cdot1\dot{7} + 5\cdot\dot{0}0\dot{8} + \cdot237\dot{1} + 456$.

(2) $456\cdot\dot{7} + 8\cdot98\dot{2} + \cdot\dot{0}0154\dot{7}\dot{6} + \cdot4\dot{1}\dot{0} + \cdot00\dot{2}\dot{7}$.

(3) $7\cdot83 - \cdot\dot{5}$; $89 - 60\cdot\dot{0}7\dot{2}$; $4\cdot09\dot{6} - 1\cdot96\dot{1}$.

(4) $6\cdot\dot{0}\dot{1} \times \cdot\dot{7}$; $\cdot\dot{0}5\dot{1} \times 7\cdot4\dot{0}\dot{2}$; $\cdot\dot{8} \times 1\cdot\dot{5}61\dot{0}$.

(5) $5\cdot3\dot{0}\dot{4} \times 4\cdot0\dot{3}\dot{5}$; $65\cdot07 \times \cdot00\dot{7}\dot{5}$; $12\cdot3\dot{4}\dot{5} \times \cdot\dot{2}\dot{5}$.

(6) $\cdot\dot{8} \div 4$; $9\cdot4\dot{6} \div 6\cdot\dot{5}$; $5\cdot\dot{0}69\dot{2} \div \cdot008\dot{1}$; $347\cdot1\dot{1}9\dot{6} \div 183\cdot\dot{0}04\dot{5}$.

Approximations

82. We have already indicated above how we may, in addition and subtraction of decimals, get an approximate result which is correct to a given number of decimal places.

We have now to see how to do the same thing in the multiplication and division of decimals.

Examples:—

(1) Multiply 15·78526009 by 6 correct to two places of decimals.

$$\begin{array}{r} 15\cdot78526009 \\ 6 \\ \hline 94\cdot711. \end{array}$$

Answer **94·71.**

We place the 6 under the third place of decimals and multiply 2 by 6 in our head in order to see what must be carried—in this case it is 1.

Sometimes it is necessary to go two places beyond the place required; for instance—

(2) Multiply 2·8978413 by 5 correct to two places of decimals.

$$\begin{array}{r} 2\cdot8978413 \\ 5 \\ \hline 14\cdot489 \end{array}$$

Here the process is as follows:—

$5 \times 8 = 40$—carry 4

$5 \times 7 = 35$; $35 + 4 = 39$—carry 3

$5 \times 9 = 45$; 45 and 3 = 48,

and so on.

Answer **14·49**, for 14·49 is more nearly = 14·489 than is 14·48.

(3) Multiply 16·8526789 by 38 to 2 places of decimals.

As in the last example we place the unit under the third place of decimals and multiply the figure in the fourth place, i.e. 6, in our head so as to carry 4.

Now when we multiply by the 3, we are really multiplying by 30, i.e. by 3×10. If we first multiplied by the 10, it would shift the decimal point one place to the right, and the figure in the fourth place would be the 7. Therefore we multiply the 7 by 3 in our head and carry 2, then multiply 6 by 3, add 2 and set the result down in the third place of decimals.

16·85267
38
134·820
505·580
640·400

Answer **640·40.**

(4) Multiply 17·05843125 by 53·58417 to two places of decimals.

Here the process is exactly the same as above, only we have begun by multiplying by the figure on the right of the reversed multiplier instead of as before by the one on the left. It is often convenient to place a cross over the figure above the units place in the multiplier in order to guide the eye.

17·05843
71485·35
852·9215
51·1752
8·5290
1·3640
680
17
7
914·0601

Answer **914·06.**

(5) Divide 52·4938472 by 7 to three places of decimals.

Here we use short division and carry the operation to four places.

7)52·4938
7·4991

Answer **7·499.**

Whenever it is feasible it is better to use short division, but cases may arise in which this is not possible.

(6) Divide 52·4938472 by 4·713.

Considering the question first as $524 \div 47$ we see that there will be 2 whole numbers. We must therefore have 4 places in the quotient, 2 of which will be whole numbers, and 2 of which will be decimals. Having noted this we may disregard the decimal point in working. To make sure of the correctness of the 2nd place of decimals we will work our quotient to 5 figures.

After the first operation we bring down the 3, and after the second operation we bring down the 8. After the third operation, instead of bringing down the next figure of the dividend, we cut off the last figure of the divisor; in the next operation we again cut off the last figure of the divisor.

11138
4713)524938472
5363
6508
471)1795
47)382
6
Quotient 11·138

Answer **11·14.**

Care must be taken not to begin cutting off the divisor too soon lest your quotient become inaccurate.

The above methods of obtaining approximate results in multiplication and division are often called contracted methods.

Exercise 29

Find by contracted methods to 2 places of decimals

(1) $27{\cdot}518 \times 35{\cdot}482$; $654{\cdot}0013 \times 584{\cdot}7$; $49{\cdot}9015 \times 2{\cdot}0018$.

(2) $4001{\cdot}0097 \times 678{\cdot}41$; $5849{\cdot}0731 \times 10{\cdot}059621$.

(3) $7{\cdot}9843561 \div {\cdot}6584$; $64{\cdot}874321 \div 31{\cdot}493$; ${\cdot}598476 \div {\cdot}9451$.

(4) $671{\cdot}856421 \div 309{\cdot}72$; ${\cdot}85910732 \div {\cdot}09365$.

Concrete Numbers

83. We have hitherto dealt with abstract numbers only. We must now turn our attention to *concrete* numbers. Since no simple relation exists which connects the different units of length, of money, of time, etc., it is necessary to commit to memory the following tables.

84. *Table of Money*

4 farthings	make	1 penny	= 1d
12 pence	,,	1 shilling	= 1s.
20 shillings	,,	1 pound	= £1

$\frac{1}{4}$d. = one farthing; $\frac{1}{2}$d. = 2 farthings = 1 halfpenny; $\frac{3}{4}$d. = three farthings.

The following coins are in use in England:

GOLD COINS

A half sovereign = 10 shillings
A sovereign = £1 = 20 shillings

SILVER COINS

A Threepenny bit = 3 pence
A Sixpence = 6 pence
A Shilling = 12 pence
A Florin = 2 shillings
A Half-crown = 2 shillings and 6 pence
A Crown = 5 shillings

COPPER COINS

A Farthing = $\frac{1}{4}$ of a penny (the smallest coin in
A Halfpenny = 2 farthings (circulation)
A Penny = 4 farthings

85. *Table of Time*

60 Seconds (sec.)	make	1 Minute	= 1 min.
60 Minutes	,,	1 Hour	= 1 hr.
24 Hours	,,	1 Day	= 1 d.
7 Days	,,	1 week	= 1 wk.
4 weeks	,,	1 Lunar Month	
365 Days	,,	1 Year	

The year is divided into 12 months called Calendar Months. The number of days in each month is as follows:

January 31, February 28, March 31, April 30, May 31, June 30, July 31, August 31, September 30, October 31, November 30, December 31.

The **Solar** Year, which is the time taken by the earth to make one complete revolution round the sun, is 365 d. 5 hrs. 48 min. 46 sec. very nearly. It would be inconvenient to reckon with a year which was not made up of an exact number of days, and therefore the **Civil** year is reckoned as 365 days. But this is nearly a quarter of a day short of the Solar Year, and consequently we should get nearly a day behind in four years' time. Therefore every four years we have a **Leap** Year, in which the month of February has one day added to it (i.e. has 29 days). Leap Year occurs whenever the number of the year is divisible by 4. Thus 1916 is a Leap Year. However, as we are not quite a whole day behind in every four years, we should ultimately get ahead of the Solar Year if we did

not sometimes drop a Leap Year. The correction for this is made by omitting three Leap Years in every 400 years, the years in which they are omitted being the centuries whose first two digits are not divisible by 4. Thus 1700, 1800, and 1900 were not Leap years, but 2000 will be a Leap Year.

The day of 24 hours is the measure of the time taken by the earth to make one complete revolution round its own axis.

86. *Tables of Weight*

AVOIRDUPOIS WEIGHT

16 Drams (dr.)	make	1 Ounce	= 1 oz.
16 Ounces	,,	1 Pound	= 1 lb.
14 Pounds	,,	1 Stone	= 1 st.
28 Pounds	,,	1 Quarter	= 1 qr.
4 Quarters (112 lbs.)	,,	1 Hundredweight	= 1 cwt.
20 Hundredweights	,,	1 Ton	

This weight is used for most substances.

TROY WEIGHT

24 Grains (grs.)	make	1 Pennyweight	= 1 dwt.
20 Pennyweights	,,	1 Ounce Troy	= 1 oz.
12 Ounces	,,	1 Pound	

Troy weight is used for weighing gold, silver, etc., and other costly substances. The pound troy is hardly ever used now.

Diamonds and precious stones are usually weighed by the **carat,** one carat being about 3¼ grains. The term carat applied to gold indicates the amount of pure metal in 24 parts of gold alloyed with some other metal.

1 Pound Avoirdupois contains 7000 grains Troy.

APOTHECARIES' WEIGHT

20 Grains (grs.)	make	1 Scruple	= 1℈
3 Scruples	,,	1 Dram	= 1ʒ
8 Drams	,,	1 Ounce	= 1℥
12 Ounces	,,	1 Pound	= 1 lb.

APOTHECARIES' FLUID MEASURE

60 Minims	make	1 Fluid Dram
8 Drams	,,	1 Fluid Ounce
20 Ounces	,,	1 pint

This should really come under the heading of measures, but it is obviously more convenient to deal with it in connection with Apothecaries' Weight. It is useful to note that 1 dram is roughly equivalent to a teaspoonful, 2 drams to a dessert-spoonful, and 4 drams to a tablespoonful.

METRIC TABLE OF WEIGHT

10 Milligrams	make	1 Centigram
10 Centigrams	,,	1 Decigram
10 Decigrams	,,	1 GRAM
10 Decagrams	,,	1 Hectogram
10 Hectograms	,,	1 Kilogram = 1 kg.
10 Kilograms	,,	1 Myriagram
10 Myriagrams	,,	1 Quintal
10 Quintals	,,	1 Millier

1 gram = 15·432 grains. 1 kilogram = 2·2046 lbs. Avoirdupois.

One gram is the weight of 1 cubic centimetre (*see* § 87) of distilled water at a temperature of 4° centigrade. The weights up to and including a kilogram are in common use, the others being rarely employed.

87. *Measures of Length*

TABLE OF LINEAL MEASURE

12 Inches (in.)	make	1 Foot	= 1 ft.
3 Feet	,,	1 Yard	= 1 yd.
5½ Yards	,,	1 Rod, Pole or Perch	= 1 po.
22 Yards	,,	1 Chain	= 1 ch.
40 Poles, or 10 Chains or 220 Yards	,,	1 Furlong	= 1 fur.
8 Furlongs or 1,760 Yards	,,	1 Mile	= 1 m.
69⅛ Miles	,,	1 Degree	= 1 deg.

A degree is $\frac{1}{360}$ of the length of the earth's circumference. The following measures are also in use—

4 Inches	make	1 Hand (in measuring horses)
6 Feet	,,	1 Fathom (in measuring the depth of water)
100 Links	,,	1 Chain (in measuring land)
3 Miles	,,	1 League

1 Palm = 3 inches, 1 Span = 9 inches, 1 cubit = 18 inches, 1 Pace = 5 feet, 1 Geographical Mile = $\frac{1}{60}$ degree.

METRIC TABLE OF LENGTH

10 Millimetres (mm.)	make	1 Centimetre	= 1 cm.
10 Centimetres	,,	1 Decimetre	= 1 dm.
10 Decimetres	,,	1 METRE	= 1 m.
10 Metres	,,	1 Decametre	= 1 Dm.
10 Decametres	,,	1 Hectometre	= 1 Hm.
10 Hectometres	,,	1 Kilometre	= 1 Km.
10 Kilometres	,,	1 Myriametre	= 1 Mm.

A metre is supposed to be one ten-millionth part of the length of a quadrant of the earth from the pole to the equator. Myriametres are rarely used as measures. 1 metre = 39·3708 inches, 1 Kilometre = 1093·63 yards.

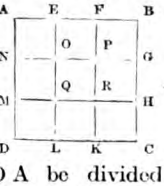
Measures of Surface

SQUARE MEASURE

144 Square Inches (sq. in.)	make	1 square Foot	= 1 sq. ft.
9 Square Feet	,,	1 Square Yard	= 1 sq. yd.
30¼ Square Yards	,,	1 Square Rod, Pole or Perch	= 1 sq. po.
40 Square Poles	,,	1 Rood	= 1 ro.
4 Roods or 4,840 Square Yards	,,	1 Acre	= 1 ac.
640 Acres	,,	1 Square Mile	= 1 sq. m.
10 Square Chains	,,	1 Acre	

A square is a flat four sided figure whose sides are all equal and perpendicular to each other.

Square measure is used for measuring land, flooring, and all surfaces. Suppose A B and B C are lineal yards placed perpendicular to each other, and the figure A B C D be completed so as to form a square. Then A B C D is a square yard. Now if each of the sides A B, B C, C D, D A be divided into 3 equal parts at the points E, F, G, H, K, L, M,



N, then each of the lengths A E, E F, F B, etc. $= \frac{1}{3}$ of a yard $= 1$ foot.

It is clear that A E O N is a square each of whose sides $= 1$ foot, i.e. A E O N $= 1$ square foot, and there are in all 9 such figures, all equal, which make up the square yard. Thus we see 9 square feet make one square yard.

Thus the first four items in the above table are derived directly from the table of Linear Measure.

METRIC TABLE OF SURFACE

1 square Decametre or 100 square Metres = 1 Are
1 hectare (Ha.) = 100 Ares
A square metre is also called 1 centiare (ca.)
1 square metre = 1,550·059 square inches
1 Hectare = 2·4711 acres.

Key to Exercise 15

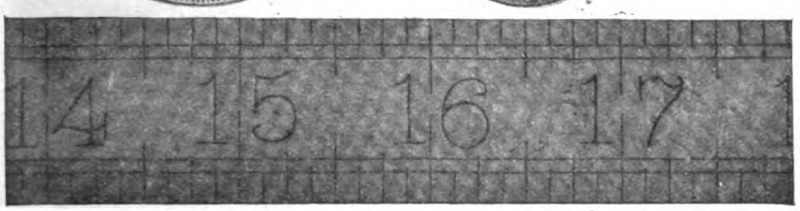
(1) $\frac{5}{8}$, $\frac{10}{9}$, $\frac{5}{2}$, $\frac{10}{3}$, 10. (2) $\frac{37}{5}$, $\frac{74}{7}$, $\frac{185}{8}$, $\frac{185}{7}$, $\frac{111}{4}$. (3) $\frac{3}{11}$, $\frac{2}{11}$, $\frac{3}{22}$, $\frac{6}{77}$, $\frac{1}{22}$. (4) $\frac{15}{65}$, $\frac{10}{55}$, $\frac{15}{105}$, $\frac{6}{65}$, $\frac{6}{265}$, $\frac{6}{3965}$, $\frac{5}{3718}$, $\frac{1}{106}$. (5) $\frac{1}{2}$, $\frac{3}{8}$, $\frac{4}{8}$, $\frac{3}{8}$, $\frac{5}{8}$, $\frac{1}{8}$, $\frac{10}{21}$, $\frac{7}{12}$. (6) $\frac{12}{17}$. (7) $\frac{7}{11}$ (8) $\frac{8}{9}$. (9) $\frac{15}{23}$. (10) $\frac{471}{8912}$. (11) $\frac{101}{111}$. (12) $\frac{15}{23}$.

Key to Exercise 16

(1) $\frac{700}{840}$, $\frac{180}{840}$, $\frac{616}{840}$, $\frac{325}{840}$. (2) $\frac{1556800}{3528000}$, $\frac{1984450}{3528000}$, $\frac{2257792}{3528000}$, $\frac{2455000}{3528000}$, $\frac{2529200}{3528000}$. (3) $\frac{196}{336}$, $\frac{63}{336}$, $\frac{108}{336}$, $\frac{65}{336}$. (4) $\frac{9000}{10000}$, $\frac{9900}{10000}$, $\frac{9990}{10000}$, $\frac{9999}{10000}$. (5) $\frac{651}{1260}$, $\frac{518}{1260}$, $\frac{1148}{1260}$, $\frac{276}{1260}$, $\frac{280}{1260}$, $\frac{1005}{1260}$. (6) $\frac{805}{840}$, $\frac{728}{840}$, $\frac{280}{840}$, $\frac{60}{840}$, $\frac{525}{840}$, $\frac{700}{840}$. (7) $\frac{8}{15}$, $\frac{98}{105}$, $\frac{23}{45}$. (8) $\frac{35}{36}$, $\frac{17}{18}$, $\frac{19}{21}$, $\frac{6}{7}$, $\frac{7}{12}$. (9) $\frac{7}{12}$, $\frac{37}{72}$, $\frac{9}{24}$, $\frac{3}{40}$. (10) $\frac{29}{30}$, $\frac{17}{18}$, $\frac{9}{10}$, $\frac{41}{48}$, $\frac{9}{10}$.

Key to Exercise 17

(1) 1. (2) 1. (3) $\frac{1}{2}$. (4) 2. (5) $1\frac{8}{17}$. (6) $\frac{18}{25}$. (7) $2\frac{1}{4}$. (8) $6\frac{35}{36}$. (9) $8\frac{17}{30}$. (10) $65\frac{35}{36}$. (11) $1\frac{5}{9}$. (12) $25\frac{51}{560}$. (13) $29\frac{71}{144}$. (14) $192\frac{95}{168}$.



The diameter of a 5s. piece is $1\frac{1}{2}$ inch.; the diameter of $\frac{1}{2}$d. is 1 inch.

Key to Exercise 18

(1) $\frac{1}{4}$. (2) $\frac{4}{15}$. (3) $\frac{1}{6}$. (4) $\frac{1}{10}$. (5) $\frac{5}{24}$. (6) $\frac{7}{20}$. (7) $1\frac{1}{4}$. (8) $17\frac{29}{105}$. (9) $\frac{13}{42}$. (10) $\frac{169}{264}$. (11) $2\frac{29}{30}$. (12) $1\frac{143}{144}$. (13) $\frac{1}{12}$. (14) $\frac{1}{52}$. (15) $1\frac{1}{14}$. (16) $75\frac{21}{55}$. (17) $5\frac{5}{8}$. (18) 2. (19) $51\frac{91}{98}$. (20) $4\frac{21}{40}$.

Key to Exercise 19

(1) $\frac{20}{33}$. (2) $\frac{7}{2760}$. (3) $\frac{1}{15}$. (4) $\frac{2}{7}$. (5) $\frac{5}{6}$. (6) $11084\frac{1}{4}$. (7) $\frac{1}{17}$. (8) $\frac{19}{27}$. (9) $\frac{4}{7}$. (10) $\frac{147}{211}$. (11) $\frac{13}{55}$. (12) 1. (13) 18. (14) $\frac{1}{8}$. (15) $\frac{1135154}{1700454}$.

Key to Exercise 20

(1) $1\frac{11}{48}$. (2) $1\frac{1}{2}$. (3) $1\frac{1}{2}$. (4) $3\frac{3}{50}$. (5) $\frac{3}{11}$. (6) $27\frac{1}{5}$. (7) $\frac{7}{55}$. (8) $1\frac{9}{40}$. (9) $\frac{5}{77}$. (10) $1\frac{2}{25}$. (11) $1\frac{13}{76}$. (12) $\frac{100054}{285278}$. (13) $2\frac{1}{5}$. (14) 5.

Sixpence and half-a-sovereign are the same size; a shilling and a sovereign are not.

Key to Exercise 21

(1) $2\frac{7}{51}$. (2) $11\frac{42}{103}$. (3) $\frac{103}{183}$. (4) 160; 1st has 16: the next two 20 each, next three 8 each, and of the rest 1 has 5 and the other five each 15. (5) Started at 7 A.M. and arrived at 6.40 P.M. (6) $\frac{5}{12}$.

Key to Exercise 22

(1) $\frac{7}{10}$, $\frac{7}{100}$, $\frac{71}{100}$, $\frac{713}{1000}$, $\frac{713}{100000}$, $\frac{7133}{1000000}$.
(2) $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{4}$, $\frac{1}{8}$, $\frac{7}{50}$, $\frac{2}{5}$, $\frac{1}{25}$, $\frac{1}{400}$, $\frac{32}{125}$, $\frac{16}{625}$, $\frac{13}{10000}$.
(3) $\frac{3}{40}$, $7\frac{1}{25}$, $1\frac{191}{125}$, $\frac{511}{1250}$, $172\frac{4}{5}$, $\frac{1001}{1000000}$, $\frac{10001}{2000000}$, $\frac{1}{5000000}$, $\frac{1}{10000000}$.
(4) ·5, ·35, ·035, ·001, ·17, ·00029.
(5) 3, 30, 300; 1·765, 17·65, 176·5; 312·5, 3125, 31250; ·0312, ·312, 3·12.
(6) ·03, ·003, ·0003; ·003, ·0003, ·00003; 39·78, 3·978, ·3978; 5·431, ·5431, ·05431; 76·52, 7·652, ·7652; 8·1, ·81, ·081.

Key to Exercise 23

(1) 211·990841. (2) 9779·600763. (3) 119·888891. (4) 2·457; ·367; 1·2958. (5) ·000002; 3·8761256. (6) ·89991; 2·099991; 1·543211. (7) ·77899; 1·6262895; 7·09905. (8) 5·767357; 3·89125.

Key to Exercise 24

(1) 15·54; 155·4; ·1554; ·01554.
(2) 279·841; 2798·41. ·0279841.
(3) 2·0083012; ·84012; 25·859856.
(4) 1; 100; ·001. (5) ·0000003125. (6) 63975;

Key to Exercise 25

(1) 8·9. (2) ·237. (3) 14·43. (4) ·2591. (5) 9200. (6) ·7. (7) ·63. (8) 9960. (9) ·000007. (10) ·0077. (11) ·0001; ·001; ·02; ·004; ·08. (12) ·00005; ·00025; ·0125; ·625; 31·25. (13) ·8329. (14) 9·6171. (15) 92·3077. (16) 2·5571. (17) 5000·3571. (18) 1·5410. (19) ·0201. (20) ·0001.

M. A. L.

ALGEBRA.—IX

Highest Common Factor

63. The integral function of highest dimensions in x, y, z . . . . . which will exactly divide two or more given integral functions, is called the Highest Common Factor (H.C.F.) of those given functions.

64. The H.C.F. of two or more monomials can be found by inspection.

Thus the H.C.F. of $2a^5b^3cd^2$, $12a^2b^4c^3d^3$, $4a^4b^2c^5d^4$ is $a^2b^2cd^2$; for the highest power of a which will divide all three monomials exactly is a^2, the highest powers of b, c and d which will divide them exactly are b^2, c and d^2. Hence the H.C.F. is a^2b^2cd.

Thus we see the H.C.F. of monomial expressions is obtained by writing down the product of all the variables that occur in all the monomials, each raised to the lowest power in which it occurs in any of them.

The student will note that the above definition does not take into account anything but variables; consequently in the foregoing example we have ignored the numerical factors. The H.C.F. of the above is sometimes written Ka^2b^2cd, when K is some constant, but it is usual to take K equal to unity, as we have done.

65. In dealing with the H.C.F. of multinomials we shall confine ourselves to one variable. Where the factors of the multinomials are known or are easily found by inspection we can find the H.C.F. at once.

Examples:—

(1) Find the H.C.F. of $x^4y^2 - x^2y^4$ and $x^3y - xy^3$

$x^4y^2 - x^2y^4 = x^2y^2(x^2 - y^2) = x^2y^2(x + y)(x - y)$

$x^3y - xy^3 = xy(x^2 - y^2) = xy(x + y)(x - y)$

$\therefore$ H.C.F. $= xy(x + y)(x - y) = xy(x^2 - y^2) = x^3y - xy^3$.

Where the linear factors of one of the functions can be easily found, we can find the H.C.F. by means of the Remainder Theorem.

(2) Find the H.C.F. of $x^6 - 6x + 5$, and $x^3 - 3x + 2$

$x^6 - 6x + 5 \equiv A$

$x^3 - 3x + 2 \equiv B$.

It is easy to see that B vanishes if we put $x = 1$

$\therefore$ $x - 1$ is a factor of B.

$B = (x - 1)(x^2 + x - 2) = (x - 1)(x - 1)(x + 2)$

$= (x - 1)^2(x + 2)$.

Trying these factors for A, we find

$A = (x - 1)^2(x^4 + 2x^3 + 3x^2 + 4x + 5)$.

Hence we see the H.C.F. is $(x - 1)^2$.

66. The following theorem is often useful in determining whether two expressions are prime to one another (i.e. have no common factor), or if not in finding their H.C.F.

If A and B be integral functions of x, *and* m *and* n *either constants or integral functions of* x, *then any common factor of A and B is also a common factor of* $mA + nB$.

Suppose that L is a common factor of A and B, then $A = \alpha L$ and $B = \beta L$, where α, β and L are all integral functions of x.

Then $mA + nB = (m\alpha + n\beta)L$.

And since m, n, α and β are all integral functions of x, it follows that $m\alpha + n\beta$ is an integral function of x, and $\therefore$ L is a factor of $mA + nB$.

It follows of course that in the same circumstances L is a factor of $mA - nB$.

It is a useful exercise for the student to prove the converse of the above, namely that

Any factor of $mA + nB$, *which is also a factor of A and not of* n, *or which is a factor of B and not of* m, *is a common factor of A and B.*

Examples:—

(1) Prove that $x^2 - x + 1$ and $x^4 - x^2 + 1$ are prime to each other.

$A \equiv x^4 - x^2 + 1$

$B \equiv x^2 - x + 1$.

By the above theorem, putting $m = 1$ and $n = -x^2$, any common factor of A and B is a factor of $A - x^2B$.

$A - x^2B = x^4 - x^2 + 1 - x^4 + x^3 - x^2 = x^3 - x^2 - x^2 + 1$

$= x^2(x - 1) - (x - 1)(x + 1) = (x - 1)(x^2 + x + 1)$.

Now it is easily seen that neither $(x - 1)$ nor $(x^2 + x + 1)$ is a factor of A or of B.

Hence we see A and B have no common factor, that is they are prime to one another.

(2) Find the H.C.F. of $x^3 - 6x^2 + 8x - 3$ and $x^3 - 7x^2 + 14x - 8$

$A \equiv x^3 - 6x^2 + 8x - 3$ $B \equiv x^3 - 7x^2 + 14x - 8$

$A - B = x^2 - 6x + 5 = (x - 1)(x - 6)$.

We find by the Remainder Theorem that $x - 1$ is a factor of both A and B, but that $x - 6$ is a factor of neither, $\therefore$ H.C.F. $= (x - 1)$.

67. In more complicated cases we have to find the H.C.F. in another way, which will be explained below, and which depends upon the following theorem.

If A, B, Q, R be all integral functions of x *such that* $A \equiv BQ + R$, *then the H.C.F. of A and B is the same as the H.C.F. of B and R.*

Since $A \equiv BQ + R$ by § 66 any factor common to B and R is a factor of A

$\therefore$ any factor common to B and R is also common to A and B.

Again $\because$ $A \equiv BQ + R$ $\therefore$ $A - BQ \equiv R$

$\therefore$ any factor common to A and B is also a factor of R

$\therefore$ any factor common to A and B is also common to B and R.

Let A and B be two integral functions whose H.C.F. is required, and let B be the function whose degree is not greater than that of A.

Divide A by B and let the quotient be Q_1 and the remainder R_1.

Divide B by R_1 and let the quotient be Q_2 and the remainder R_2. Divide R_1 by R_2 and let the quotient be Q_3 and the remainder R_3, and so on.

Now the degree of each remainder must be less than that of the corresponding divisor, and consequently by continuing the process we reach the following results: either at some stage the remainder vanishes, or it is reduced to a constant.

It is clear that we shall have the following series:

$$\begin{aligned} A &= BQ_1 + R_1 \\ B &= R_1Q_2 + R_2 \\ R_1 &= R_2Q_3 + R_3 \\ R_2 &= R_3Q_4 + R_4 \\ &\dots\dots\dots\dots \\ R_{n-2} &= R_{n-1}Q_n + R_n. \end{aligned}$$

Now by the above theorem the H.C.F. of A and B = H.C.F. of B and R_1 and the H.C.F. of B and R_1 = H.C.F. of R_1 and R_2 = H.C.F. of R_2 and R_3 = ... H.C.F. of R_{n-1} and R_n.

If at any stage the remainder vanishes, we have $R_n = 0$ and $\therefore R_{n-2} = R_{n-1}Q_n$. Hence H.C.F. of R_{n-2} and R_{n-1} = H.C.F. of (QR_{n-1} and R_{n-1}) = R_{n-1}.

And this must be the H.C.F. of A and B.

If at any stage the remainder reduces to a constant K, then R_n = K and the H.C.F. of A and B = H.C.F. of R_{n-1} and R_n, i.e. of R_{n-1} and K. But nothing but a constant will exactly divide K $\therefore$ A and B have no H.C.F. except a constant which does not constitute an H.C.F. in the algebraic sense.

Hence if at any stage the remainder vanishes, the last divisor is the H.C.F. of the 2 functions; if the remainder reduces to a constant, they have no H.C.F.

Example:—

Find the H.C.F. of $x^4 - x^3 - x^2 - x - 2$ and $x^4 - 2x^3 - 2x^2 - 2x - 3$.

$$\begin{array}{r|l} x^4 - 2x^3 - 2x^2 - 2x - 3 & x^4 - x^3 - x^2 - x - 2 \;(1 \\ \hline x^4 - 2x^3 - 2x^2 - 2x - 3 & \\ \hline x^3 + x^2 + x + 1 & x^4 - 2x^3 - 2x^2 - 2x - 3 \;(x - 3 \\ & x^4 + x^3 + x^2 + x \\ \hline & -3x^3 - 3x^2 - 3x - 3 \\ & -3x^3 - 3x^2 - 3x - 3 \\ \hline & \cdot \quad \cdot \quad \cdot \quad \cdot \end{array}$$

Hence H.C.F. = $x^3 + x^2 + x + 1$.

It is clear that in the above process we substitute for the 2 original functions a succession of pairs of functions of diminishing degree, each of which pairs has the same H.C.F. as the original pair. Hence at any stage of the proceedings we may multiply or divide any one of these functions by a constant, or by any integral function which contains no factor common to the original 2 functions.

This enables us to simplify the process and avoid fractions.

Example:—

Find the H.C.F. of $x^2 - 4y^2 + 12yz - 9z^2$ and $x^2 + 2xz - 4y^2 + 8yz - 3z^2$

$$\begin{array}{r|l} x^2 - 4y^2 + 12yz - 9z^2 & x^2 + 2xz - 4y^2 + 8yz - 3z^2 \;(1 \\ \hline x^2 - 4y^2 + 12yz - 9z^2 & \\ \hline 2xz - 4yz + 6z^2. & \end{array}$$

We can divide this remainder by the constant 2 and by z which is obviously not a factor of the 2 original functions.

$$\begin{array}{r|l} x - 2y + 3z & x^2 - 4y^2 + 12yz - 9z^2 \;(x + (2y - 3z) \\ & x^2 - 2xy + 3xz \\ \hline & x(2y - 3z) - 4y^2 + 12yz - 9z^2 \\ & x(2y - 3z) - 4y^2 + 12yz - 9z^2 \\ \hline & \cdot \quad \cdot \quad \cdot \end{array}$$

H.C.F. = $x - 2y + 3z$.

68. To find the H.C.F. of any number of integral functions of A, B, C, D . . . .

we first find the H.C.F. of A and B, say H_1; then the H.C.F. of H_1 and C, say H_2, and so on.

The student must realise that the algebraic H.C.F. is not at all the same thing as the arithmetic H.C.F. In the former highest refers to the degree of the variable, in the latter to the numerical value of the factor. Now it is easy to see that by assigning a suitable value to a, namely a + ve value < 1, we may make a^2 numerically less than a, so that while a^2 is higher in degree than a, it is numerically $< a$. Further, if we assign a particular value to the variable, the algebraic and arithmetic H.C.F.s of the two functions will in general not be identical.

Consider $2x^2 - 6x + 4$ and $x^2 - x - 2$. Their H.C.F. will be found to be $x - 2$. Now suppose $x = 5$, the first expression becomes 24, and the second 18. The H.C.F. of 18 + 24 = 6.

But if we put the value $x = 5$ in the algebraic H.C.F. we get 3.

69. Lowest Common Multiple.

The integral function of the least dimensions in x, y, z . . . . which is exactly divisible by two or more given integral functions, is called their Lowest Common Multiple or L.C.M.

In the case of monomials we must simply write down the continued product of each of the variables raised to the highest power to which it occurs in any of the functions.

Thus the L.C.M. of $2a^5b^3cd^2$, $12a^2b^4c^3d^3$, $4a^4b^2c^5d^4$ is $a^5b^4c^5d^4$ or this product multiplied by any constant K.

70. Consider two integral functions of a single variable x, say A and B. Suppose H = their H.C.F. then $A \equiv \alpha H$, $B \equiv \beta H$.

Where α and β are two integral functions prime to each other.

Then the L.C.M. of A and B = $\alpha \beta H$.

Hence to find the L.C.M. of two integral functions A and B, we first find their H.C.F., H, and then multiply this by the quotients of A and B divided by H.

Note where A and B prime to each other, H = 1.

Where the factors of the functions are given or easily found, we may proceed on similar lines to those followed in the case of monomials.

Example:—

Find the L.C.M. of $(x - 1)^2$, $x^2 - 3x + 2$, $x^2 - 6x + 9$. $(x - 1)^2 = (x - 1)^2$

$x^2 - 3x + 2 = (x - 1)(x - 2)$

$x^2 - 6x + 9 = (x - 3)^2$

L.C.M. = $(x - 1)^2 (x - 2) (x - 3)^2$.

Exercise 11

Find the H.C.F. of—

(1) $5x^3y$, $4xy^2$, xyz. (2) a^2bcd^3, $a^5b^3c^2d^2$.

(3) $(x-1)^2$, $(x^2-1)^2$, x^2-5x+4.

(4) $2x^3+3x^2y-y^3$ and $4x^3+xy^2-y^3$.

(5) $x^8+4x^6+8x^4+7x^2+4$ and $x^8+4x^6-x^2-4$.

(6) Prove that $x-1$ and x^2+1 are prime to one another.

Find the L.C.M. of—

(7) $2x^2yz$, $7y^2z^3$, x^2yz^2.

(8) $(x-1)^2$, $(x^2-1)^2$, (x^3-1), $(x-1)^3$.

(9) $4a^2-5ab+b^2$, $3a^3-3a^2b+ab^2-b^3$.

(10) $8x^3+27$, $16x^4+36x^2+81$, $6x^2-5x-6$.

(11) x^4+x^2+1, x^4-x^2+1.

(12) Show that if ax^3+bx^2+cx+d and $a'x^3+b'x^3+c'x+d'$ have a common quadratic factor in x, then $\frac{ba'-b'a}{ad'-a'd}=\frac{ca'-c'a}{bd'-b'd}=\frac{da'-d'a}{cd'-c'd}$.

Key to Exercise 10

(1) $x^3-2x^2+\frac{5}{2}x-8+\left(\frac{101}{4}x^2-3x+49\right)\cdot\left(x^3+2x^2+\frac{3}{2}x+6\right)$.

(2) $(x-a)^3-(x-a)^4+1$. (3) $p=-5$, $q=11$.

(4) $67y^4$. $\frac{67}{16}x^4$.

(5) $3(b-c)(c-a)(a-b)$.

(6) $-(y-z)(z-x)(x-y)\{y^2z^2+z^2x^2+x^2y^2+xyz(x+y+z)\}$

(7) $(x+y+z)(yz+zx+xy)$.

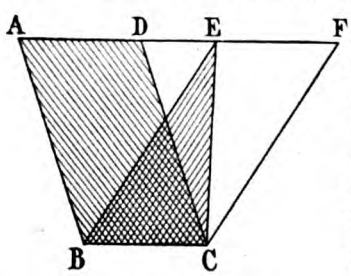
(8) $12abc(a+b+c)$. M. A. L.

GEOMETRY.—VIII

Proposition 35. Theorem

If a triangle and a parallelogram are on the same base and between the same parallels (i.e. have the same altitude), the parallelogram is double of the triangle in area.

Let A B C D be a ▱ and E B C a △ on the same base B C and between the same ‖s A E, B C.



It is required to prove that ▱ A B C D = 2 △ E B C in area.

Proof.—Through C draw C F ‖ to B E meeting A E produced in F (Prop. 29).

Then E B C F is a ▱, and E C is its diag.

∴ ▱ E B C F = 2 △ E B C (a diag. of a ▱ bisects it—Prop. 31)

but ▱ E B C F = ▱ A B C D (on same base and between same ‖s—Prop. 33)

∴ ▱ A B C D = 2 △ E B C.

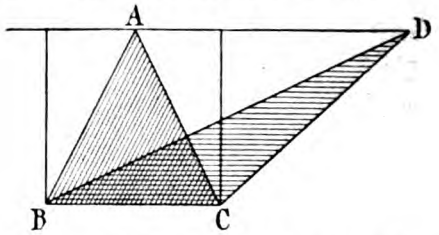
Corollary 1.—*The area of a triangle is half the product of its base multiplied by its height.*

Corollary 2.—*If two triangles are on the same base and between the same parallels they are equal in area.*

Each is equal to half the same rect. or ▱.

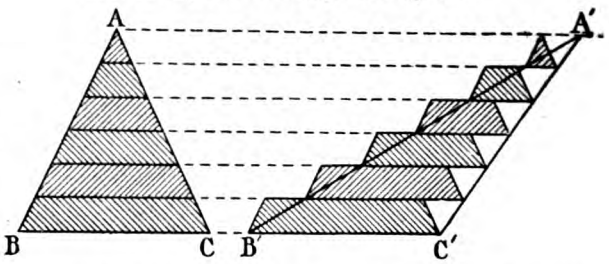
Corollary 3.—If two triangles have equal bases and equal altitudes they are equal in area.

Corollary 4.—If two triangles are equal in area and are on equal bases, they have equal altitudes. And if two triangles are equal in area



and have equal altitudes, then their bases are equal.

The accompanying figure illustrates Corollaries 3 and 4, and is on the same principle as the figure illustrating the corollary to Prop. 33.



Definition.—A trapezium is a four-sided figure which has two of its sides parallel.

Area of a trapezium.

If A B C D be a trapezium having A B ‖ to D C, join B D.

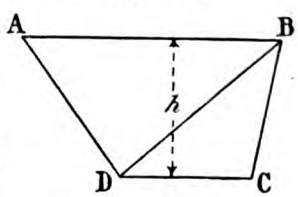
The area of A B C D = area of △ A B D + area of △ C B D.

Now if the altitude of △ A B D be h units (i.e. the ⊥ dist. between A B and D C), then the altitude of △ C B D = h units

∴ area of △ A B D + area of △ C B D = $\frac{1}{2}$ A B × h + $\frac{1}{2}$ C D × h = $\frac{1}{2}h$(A B + C D)

∴ area of A B C D = $\frac{1}{2}h$ (A B + C D)

i.e. the area of a trapezium equals one-half of the product of the sum of the parallel sides and the perpendicular distance between them.



Definition.—If through any point P on a diagonal A C of a parallelogram A B C D, straight lines are drawn parallel to the sides, four small parallelograms are formed; two of these have the diagonals A P, C B, and are called the **parallelograms about the diagonal** A C; the other two are called the **complements** of the two former.

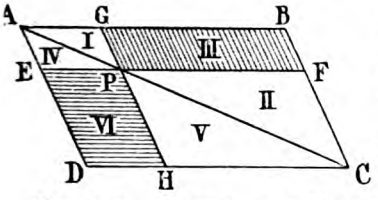
Proposition 36. Theorem

The complements of parallelograms about a diagonal of a parallelogram are equal.

Let III and VI be the complements of the ▱s about the diag. A C of the ▱s A B C D.

Let the ▱s about the diag. A C be A G P E, P F C H.

It is required to prove that III = VI.



Proof. — △ I + △ II + ▱s III = △ IV + △ V + ▱s VI. (∵ A C bisects the ▱s A B C D — Prop. 31.)

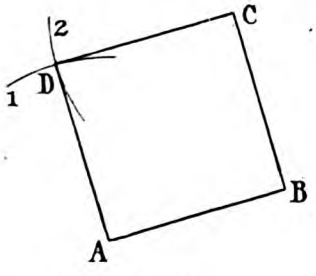
But △ I = △ IV (∵ A P bisects ▱s A G P E — Prop. 31)

and △ II = △ V (∵ P C bisects ▱s P F C H — Prop. 31)

∴ ▱s III = ▱s VI (by subtraction).

Proposition 37. Problem

On a given straight line to construct a square.



Let A B be a straight line of given length.

At B draw B C ⊥ to A B (Prop. 21) making B C = A B.

With centre A and radius A B describe ○ 1.

With centre C and radius = A B describe ○ 2 cutting ○ 1 at D.

Join A D, C D.

Then A B C D is the required sq.

Proof.—A B C D is a quadrilateral having all its sides equal, and the ∠ at B is a rt. ∠.

Proposition 38. Problem

To construct a parallelogram equal to a given triangle and having one angle equal to a given angle.

Let A B C be the given △ and α the given ∠.

Bisect B C at D (Prop. 20).

At D make the ∠ β = α (Prop. 18).

Through A draw A H ‖ to B C (Prop. 29).

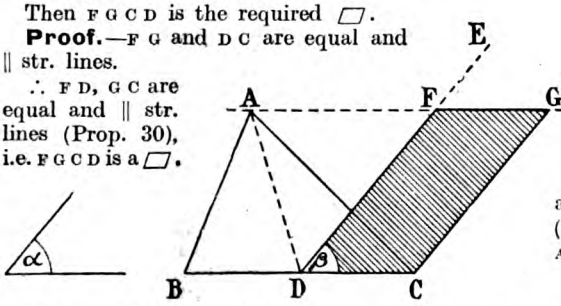
Let A H cut D E at F. From F H cut off F G = D C.

Join G C.

Then F G C D is the required ▱.

Proof.—F G and D C are equal and ‖ str. lines.

∴ F D, G C are equal and ‖ str. lines (Prop. 30), i.e. F G C D is a ▱.



If A D be joined, △ A B D = △ A C D (they have equal bases and same altitude. Cor. 3, Prop. 35).

∴ △ A B C = 2 △ A D C.

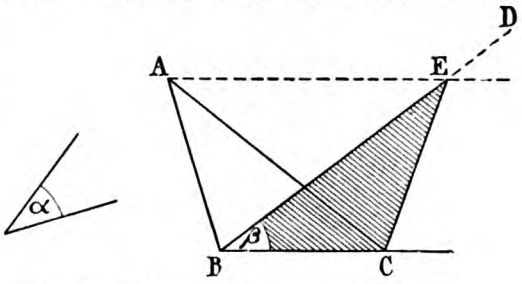
▱ F G C D = 2 △ A D C (on same base and between same ‖s—Prop. 35).

∴ ▱s F G C D = △ A B C.

Also β = α (construction).

Proposition 39. Problem

To construct a triangle equal in area to a given triangle and having an angle equal to a given angle.



Let A B C be the given △ and α the given ∠.

At B make ∠ β = α (Prop. 18).

Through A draw a line ‖ to B C (Prop. 29) cutting B D at E.

Join E B, E C.

Then B E C is the required △.

△ B E C = △ B A C (on the same base and between the same ‖s. Cor. 2, Prop. 35).

β = α (construction).

Proposition 40. Problem

To construct a triangle equal in area to a given triangle having one side of given length and having one angle unchanged.

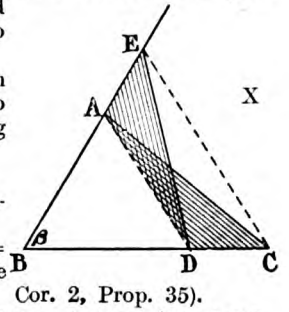
Let A B C be the given △, X the length of the given side, β the ∠ which is to be unchanged.

From B C, produced if necessary, cut off B D = X.

Join A D. Through C draw a line ‖ to A D (Prop. 29) and cutting B A produced in E.

Join E D.

Then B E D is the required △.



Proof.—△ A E D = △ A D C (on same base and between same ‖s. Cor. 2, Prop. 35).

∴ △ A D B + △ A E D = △ A D B + △ A D C

∴ △ B E D = △ B A C.

Proposition 41. Problem

To construct a triangle equal in area to a given quadrilateral.

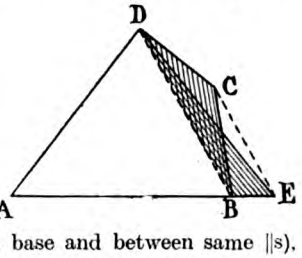
Let A B C D be the given quadrilateral.

Join B D.

Through C draw a line ‖ to D B (Prop. 29) cutting A B produced in E.

Join D E.

Then A D E is the required △.



Proof.—△ B D E = △ B D C (on same base and between same ‖s).

∴ △ A D B + △ B D E = △ A D B + △ B D C

∴ △ A D E = quad. A B C D.

Proposition 42. Problem

To construct a triangle equal in area to a given pentagon.

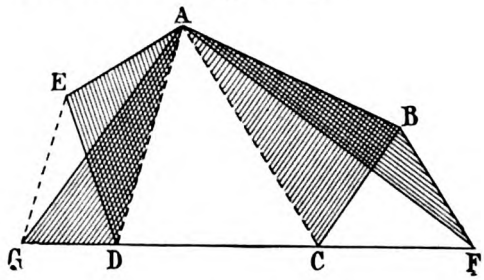
Let A B C D E be the given pentagon.

Join A D, A C.

Through B and E draw str. lines ‖ to A C, A D respectively, cutting C D produced in both directions at F and G respectively (Prop. 29).

Join A F, A G.

Then A F G is the required △.



Proof.—

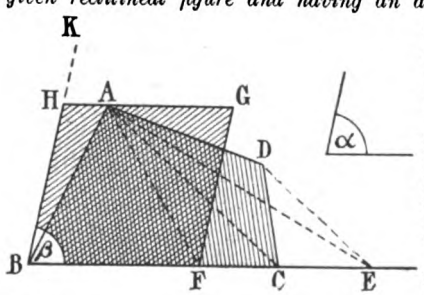
△ A C F = △ A C B } (on same base and between
△ A D G = △ A D E } same ‖s. Cor. 2, Prop. 35)

∴ △ A D C + △ A C F + △ A D G
= △ A D C + △ A C B + △ A D E
∴ △ A F G = pentagon A B C D E.

Note this method, if repeatedly applied, makes it possible to reduce a polygon of any number of sides to a triangle equal to it in area.

Proposition 43. Problem

To construct a parallelogram equal in area to any given rectilineal figure and having an angle equal to a given angle.



Let A B C D be the given rectilineal fig. and α the given ∠.

By the method of Props. 41 and 42, reduce the fig. A B C D to △ A B E, which is equal in area to A B C D.

Bisect B E at F (Prop. 20).

At B in line E B, make ∠ β = α.

Through A draw a line ‖ to B E cutting B K at H. Through F draw a line ‖ to B H cutting H A at G. (Prop. 29).

Then B F G H is the required ▱.

Proof.—▱ B F G H = 2 △ A F E (on same base and between same ‖s—Prop. 35).

△ A B F = △ A F E (on equal bases and between same ‖s. Cor. 3, Prop. 35).

∴ △ A B E = 2 △ A F E
∴ ▱ B F G H = △ A B E
but △ A B E = fig. A B C D (construction)
∴ ▱ B F G H = fig. A B C D
and β = α (construction).

Proposition 44. Problem

To construct a parallelogram having a given straight line as one side, having an angle equal to a given angle, and equal in area to a given triangle.

Let A B be the given str. line, α the given ∠ and I the given △.

Construct △ B E F on A B produced having its sides = those of △ I. (Prop. 17).

At B make ∠ E B M = α (Prop. 18).

Bisect B E at G (Prop. 20).

Through F draw K F M H ‖ to A E (Prop. 29).

Through G draw G H ‖ to B M (Prop. 29).

Through A draw A K ‖ to B M or G H (Prop. 29).

Join K B.

K B produced must meet H G produced, for A K and G H are ‖.

Let them meet at L.

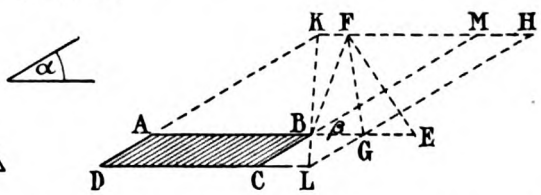
Through L draw L C D ‖ to A B (Prop. 29)

Meeting M B and K A produced in C and D.

Then A B C D is the required ▱.

Proof.—Join G F.

A B C D, M B G H, D L H K are ▱s (construction)
∴ complement A B C D = complement M B G H (Prop. 36).



▱ M B G H = 2 △ B F G (on same base and between same ‖s—Prop. 35)

△ B F G = △ E F G (on equal bases and between same ‖s. Cor. 3, Prop. 35).

∴ △ B E F = 2 △ B F G = ▱ M B G H
∴ ▱ M B G H = I
∴ ▱ A B C D = I
and ∠ A B C = vert. opp. ∠ β (Prop. 3)
= α (construction)
and A B is a side of the ▱ A B C D.

Exercise 10

(1) Any parallelograms A B D E, A C F G are described externally on the sides A B, A C of a triangle A B C. If D E and F G be produced to meet in H, and B K, C L are drawn parallel and equal to H A, show that parallelogram B K L C equals the sum of parallelograms A B D E and A C F G.

(2) Triangles equal in area and on the same base, and on the same side of it, are between the same parallels.

(3) If A B C D be a parallelogram, and P and Q are any points on A C, show that triangles B P Q, D P Q are equal in area.

(4) The base B C of a triangle A B C is bisected at D. A D is produced to E, so that D E = A D, C E is joined; show (1) triangle A E C = △ A B C in area, (2) that A D is less than half the sum of A B and A C.

(5) The sides B C, C A of a triangle A B C are produced to D and E respectively, so that C D = B C and A E = A C; show that triangles E A D and A B C are equal.

(6) A B C D is a parallelogram and the straight line P Q is drawn parallel to the diagonal B D meeting B C at P and C D at Q; show that △ A B P = △ A D Q.

M. A. L.

Continued from Vol. I., page 512.

BUSINESS AND COMMERCE:

***Contributors*:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).**

COMMERCIAL TRAINING.—IX

In the writing of business letters brevity, clearness and accuracy are the chief points to study.

A letter must be brief, because business men have not the time or inclination to read superfluous words. It must be clear, because business misunderstandings lead to loss of time and of money as well. It must be accurate, as there is no provision made in the world of commerce for mistakes.

A Clear Style

But because each paragraph is stiff and direct, it does not follow that a letter need be curt. Courtesy is better than curtness in any walk of life. In the same way a correspondence clerk should take a real pride in every letter he writes, so that his firm may have the name and reputation for good letters.

There are still a few firms where the handwritten letter prevails, and with such correspondence neatness and legibility are the prime factors. Neither blots nor smudges should appear, and the letter should be so spaced that it nicely fills the centre of the sheet or sheets. It is not always an easy matter to ensure even alignment when writing with a pen upon quarto notepaper (8 × 10), but this difficulty may be corrected by placing behind the sheet a second sheet ruled with thick black lines evenly spaced. These heavy lines will show through the upper sheet and form a guide to the correspondent.

In the case of typewritten letters there is no trouble with the alignment, but a certain judgment must be exercised to ensure that the matter is well balanced on the sheet, and spaced out in a neat and craftsmanlike way.

It goes without saying that a business letter should be written in good, sound English. Mistakes of grammar are as bad as mistakes of spelling.

Another point to bear in mind is that of paragraphing. All letters should be nicely broken up into paragraphs, and also into sentences, for without these finishes they must inevitably be heavy and confusing. In the majority of cases no one paragraph should exceed eight lines in length, and no sentence twenty words. When beginning a new paragraph indent it five spaces on the typewriter, or about three-quarters of an inch when working with a pen.

To prevent confusion, and also to assist in referring back in the files, replies to business letters generally begin: *Referring to your letter*, or *In reply to yours*. Then follows the date of the letter to which the one in hand replies. The following rules should be observed: A letter written and replied to on the same day is *In reply to yours of even date*; a letter written on any day of the present month is *In reply to yours of the 16th instant*; in the case of the month that has passed *In reply to yours of the 30th ultimo*; whilst a matter in the future is expressed *We should be glad if on the 7th proximo*, etc. *Instant* is sometimes abbreviated to *inst.*; *ultimo* to *ulto.* or *ult.*; *proximo* to *prox.*

Signing Letters

Some firms identify the subjects of their letters by an underscored headline; thus, the words *In re* meaning *In reference to:*

In re Claim for Damages.

Usually this identification is used when one writes to one firm or individual upon a number of matters, though solicitors invariably make the custom a firm rule.

In the signing of letters there are certain formalities to be observed. An important official of a company would probably sign correspondence in his official capacity, thus:

PAUL J. DAWSON,
Managing Director,

or,

MONTGOMERY FRY,
Secretary.

With lesser folk, such as clerks and others

who have the writing of letters on a firm's behalf, the signature is usually

FRY, DAWSON & CO., LTD.,
p.p. A. B. C.

p.p. is an abbreviation of *per procurationem*, and is sometimes written *per pro.*, and occasionally *p. pro.* The initials A. B. C. above are intended to correspond with those of the clerk signing the letter. In some offices letters are signed :

For FRY, DAWSON & CO., LTD.,
A. B. C.

and to be strictly accurate the *per pro.* should come *before* the name of the firm, though in practice it is often written before the name of the person initialling the letter.

Clerks and others called upon to dictate letters to shorthand writers should make a point of speaking with the utmost clearness, and of not uttering their words too quickly or abruptly.

It is a great accomplishment to compose and dictate simultaneously: it is an art that should be practised in privacy at home, first by reading a paragraph from a book, and then by repeating it out loud from memory so far as possible. By following this simple plan greater fluency and ease of dictation should ensue. A hesitant, jerky dictator is extremely difficult even for an expert stenographer to follow. As a matter of fact, the person dictating should first carefully read over the letter to which he is replying or consult any notes he may have on the subject about which he is writing; then he should quickly think out the lines of his letter and commence dictation. By the interpolation of the words "full stop; new par." the shorthand writer will know how to type the letter when the time comes for transcribing, and any similar details are much appreciated, such as the hint "in words" before certain groups of figures or "numerals" in the opposite case.

Below is given an example of how to write a business letter on good commercial lines.

The whole point of this example lies in the fact that it is perfectly clear, straightforward and simple. In every case where a number of articles are ordered by letter the adoption of a system of tabulation is preferable, for by its use the order may be checked with complete accuracy and executed with the same degree of certainty.

Certainly it is better to incorporate the order in the letter rather than to type it on a separate sheet and enclose it with a covering note.

It should be noted, too, that when material is being exported, the actual day on which the ship closes for the receipt of cargo should be quoted. This information is afforded by the shipping lists, which are available in all offices that have to do with exporting.

A. B.

Messrs. Robinson & Brown,
20 Eureka Street,
BRIGHTON.

Dear Sirs,

Will you please dispatch to Mr. James Wilson, 88 Quebec Street, Montreal, Canada, by S.S. "Iron Duke" closing at Avonmouth Docks, Bristol, on the 3rd prox., the following goods:

12 Sheets Corrugated Iron Roofing, galvanised, 6 ft., 24 gauge.
12 Rolls Galvanised Wire Netting, 3-inch mesh, 1 yard wide, 50 yards to the roll.
2 Cwts. Mixed French Wire Nails, and
1 Garden Roller, double-cylindered, 16 x 16, 2 cwt.

Yours truly,

CHOOSING A CAREER.—IX

Emigration—(*continued from Vol. I., p.* 507).

THE WEST INDIES, though situated within the tropics, are remarkably healthy and profitably fertile.

They embrace Jamaica, the Bahamas, the Leeward Islands, the Windward Islands, Barbados, Trinidad and Tobago, Honduras and Guiana, all islands with the exception of the two latter, Honduras being in Central America, and Guiana to the North of the South American continent.

Sugar is the main industry of the West Indies, but cocoa, tobacco, cotton, and fruit are also grown. So far as sugar is concerned, it calls for much capital and local experience, and the manual work is practically all done by coloured people. Sugar growing in the main is in the hands of large proprietors, who have had considerable connection with the country, but young men can often obtain posts on the estates at about £1 a week, with board and lodging.

Only young people should emigrate to the West Indies, for a tropical climate often has a most injurious effect upon those beyond middle age.

Jamaica is the centre of the banana trade of the West Indies. Bananas may be grown with comparatively little capital, the cost of cultivation being from £6 to £10 an acre per year, whilst the first crop is harvested about one year after planting. For those who can afford to wait, a remunerative crop is to be obtained from oranges some five years after planting, and land may be bought on this island at from £1 per acre, payable over a period of ten years.

Trinidad offers land to the purchaser at from 50s. per acre, but labour is dear, and the climate both hot and damp. So far as farming is concerned, the island offers nothing to the British agriculturist who possesses only trifling capital.

Tobago, one of the smallest of the islands, offers land at from £1 an acre, but there is no opening for British artisans or farm labourers, and only those agriculturists with a capital of a few hundred pounds could hope to prosper.

Guiana has room for a great many immigrants of the required type. Sugar, rubber, limes, and rice are the principal products, though it is anticipated that cattle-raising will become a most important industry.

Barbados is quite a healthy island, 21 miles long, and 14 broad, and its principal industries are sugar and cotton. All the land is in a high state of cultivation, and sells at about £20 an acre. There are no openings for white labourers, and instead of settlers being sought for, there is actually emigration from the island.

The *Windward* and *Leeward Islands* offer nothing to the white labourer, but here again there are opportunities for young men possessed of a little capital who can devote a year or so of their time to making themselves acquainted with the local conditions before embarking upon their own estates.

Though situated in the tropics, the West Indies are remarkably healthy. Sugar is the main industry; cocoa, tobacco, cotton, etc., are also grown.

Before coming to a decision regarding emigration the would-be settler should consult the *Emigrants' Information Office*.

Turning our attention to quite another part of the world:

The *FEDERATED MALAY STATES* and the *STRAITS SETTLEMENTS* offer an opening for young men with capital who will become planters. The climate is tropical, and the rough labour of the fields and tin mines is performed by Chinese and natives. Rubber and most other tropical products are raised.

The *EAST AFRICAN PROTECTORATE* is, to all intents and purposes, in an experimental stage, but it is undoubtedly a country with a great future, and the commencement of agricultural development has been full of fruitful promise. In this Protectorate trade has been opening up very

Photo: James Johnston, M.D.

LOADING BANANAS AT JAMAICA.

Bananas may be grown with comparatively little capital, the cost of cultivation being from £6 to £10 per acre per annum.

fast, and even the local demand for cattle often exceeds the supply. The area under wheat is increasing every year, and large plantations of rubber have been profitably established. There are vast forests here awaiting the enterprise of capital and labour, and land may be obtained on favourable terms.

The Protectorate may be divided into two parts, the highlands and lowlands. In sections of the highlands the climate is not unlike that of a perfect English summer, but the lowlands are tropical. Nairobi is the chief settlement, and the intending settler may write to the Land Office there for information as to land, whilst other inquiries should be directed to the *Emigrants' Information Office.*

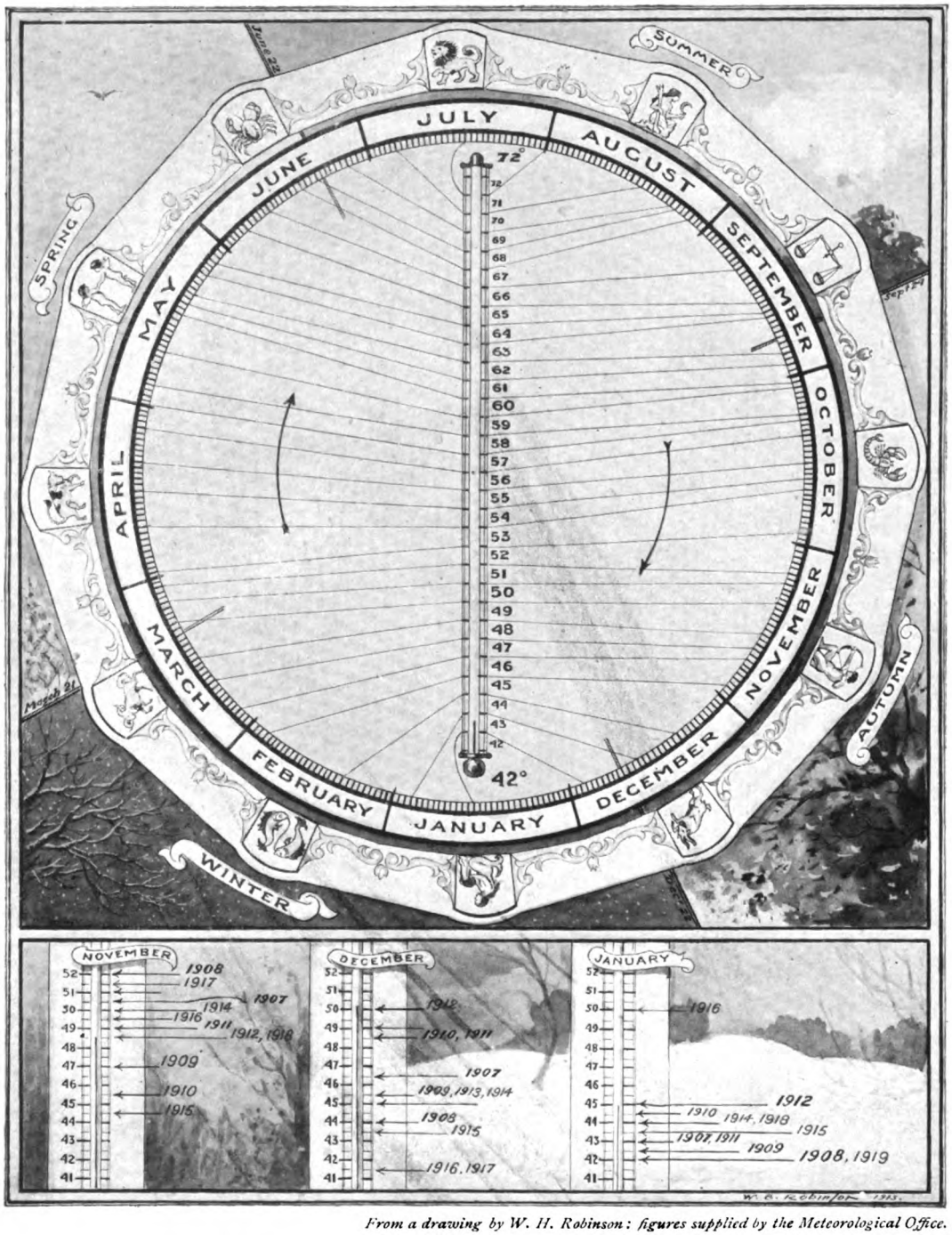
The *WEST COAST OF AFRICA* is quite unsuited for colonisation by European settlers, as the climate renders continuous residence on the coast for any long period quite impossible. There is no opening for unskilled labour, and the Europeans required for the mining and other industries are invariably engaged at home, and not locally.

For those with limited capital but unlimited energy there are no better countries to which to emigrate than Canada, Australia, and New Zealand. Those with capital to back up their endeavours have a very much wider choice, but the greatest possible care must be exercised, and only the advice of reliable friends actually living in the countries or closely in touch with prevailing conditions should be taken. The *Emigrants' Information Office*, so often mentioned, and to which we are indebted for much of our detail in this series, should invariably be consulted. This office has been established by the British Government solely for the purpose of assisting with official advice and guidance the prospective settler.

To the young man with the whole world before him there will naturally come the thought, how would he fare in a country not under the British Flag; and when considering this matter even more care and judgment must be exercised, for there are countries where the land of foreigners may be confiscated on the most trivial plea.

It is true that one may seek the ever-present aid of the *Emigrants' Information Office* even in these matters, but this office has only official knowledge of conditions in British Colonies and Dependencies. There are consul-generals to whom emigrants may write, though these foreign representatives do not accept responsibility for the information they give.

A. C. M.



From a drawing by W. H. Robinson: figures supplied by the Meteorological Office.

A GUIDE TO THE YEAR'S TEMPERATURES

The above chart shows the mean maximum temperatures which are registered on each day of the year in London. The reading given by the thermometer for any given day is the average temperature for that day over a period of thirty years. By following the lines which run from the degree marks on the thermometer to the marks indicating days on the inner edge of the circle, it will be seen, for example, that the average temperature for the first five days of July is 70°, for the next twelve days 71°, and for the remaining days of the month 72°. The drawings on the lower part of the page give the average mean maximum temperatures for the months of November, December, and January for years between 1907 and 1919.

Continued from page 8.

ENGLISH LANGUAGE AND LITERATURE:

Contributors:—ENGLISH LANGUAGE (W. A. Craigie, M.A., LL.D.; E. W. Edmunds, M.A.). ENGLISH LITERATURE (John Derry, J.P.). PHILOSOPHY (E. H. Tripp, Ph.D.). POLITICAL ECONOMY (J. W. Urwin). ETHICS (W. H. Koebel). PUBLIC SPEAKING (J. W. Urwin).

THE DRAMATIC WORKS OF SHAKESPEARE.—I

AT the plays of William Shakespeare con- 1 the most powerful literature of human ,racter which the mind of man has pro- .uced is universally admitted.

In tragedy, three Greek writers and Shakespeare form a group unapproached. But while Æschylus, Sophocles, and Euripides did all that could be done in tragedy under the limitations of the Greek drama, Shakespeare reached an intensity as poignant as theirs, with a far wider range of life, and a more human note.

In comedy Shakespeare equally challenges the greatest for pre-eminence.

Comedy and Tragedy

These exclusive claims may be doubted, at first, by anyone who takes up Shakespeare's works at random; for it is possible a play may be selected for first acquaintance containing writing that candour must acknowledge to be trivial, crude, artificial, and in some degree gross. More than almost any other writer Shakespeare must be read in sequence along the lines of development of his character and literary genius; and judgment must wait until the climax of his dramatic achievements is reached.

In the exuberance of youth he began as an imitator of plays that were popular when play-making was still in a state of crude experiment; and he had to find his way to better methods, fired by new aims which could only be realised through freer forms of literary expression. And, in doing so, he *made* the drama of which he is the transcendent exponent — the drama that covers the whole of human life. He grew as his work grew. Experience of life, broad, eager, intense, ever-widening knowledge, ever-deepening thought re-made him, as it were, while the years passed, and such was his magical power over language that he may be said to have spoken successively with fresh tongues. It is essential, therefore, that we should study the parallelism between Shakespeare's works and his life, and should know, broadly, at what stage in his development any particular play was written.

The ordinary grouping of the plays as Comedy, History and Tragedy is actively misleading, for it draws the reader away from the natural sequence. It was one of the glories of Shakespeare's craftsmanship that he used tragedy and comedy as foils to each other in the same play, and in the histories. Several of the plays will not fit into any one category. In point of time the writing of comedies, histories, and tragedies was to a considerable extent intermixed, though the greatest tragedies group themselves a few years on either side of the poet's fortieth year.

Chronological Sequence of the Plays

Much labour has been expended on the establishment of an accepted general sequence for the plays in order of time—labour made difficult by the absence of records when plays were written, or were first acted, and also by the widely varying intervals between acting and publication. But though exact dates cannot be accepted in many cases as a certainty, the general sequence, as the plays came from Shakespeare's pen, is amply proved, and it throws a clear light on the growth of the poet's powers and aims.

Four well marked periods must be noted. First there was imitative youth in its apprentice years. During this time, lasting till about 1594, Shakespeare's work was partly revision and expansion of old plays, sometimes in collaboration with others, the

poet's special qualifications being not only a new taste and literary power but also a growing stage experience, that enabled him to judge dramatic effects from an actor's standpoint. Now, too, he was writing original comedies that display a young man's light-hearted exuberance, and acceptance of styles that happened to be the vogue ; and, in tragedy, a glowing and effusive passion. Further, particularly in the historical plays, there was an admiring appreciation and imitation of Marlowe's pronounced style. Shakespeare never freed himself from Marlowe's influence, and never became his natural self, during Marlowe's life, yet his own was a much broader and profounder, though not more vigorous, mind. This was the period of the Shakespearean poems, and probably many of the sonnets.

Early Comedies

Next came five or six years of varied and successful activity during which, by writing in independence of all exterior help, chiefly comedy and history, the poet established his position as the unchallenged master of English drama, the mirror of patriotism, and the founder of a style of comedy marked by a poetic and intellectual beauty then and since unexampled.

The third period produced the great tragedies, in which, through a profound psychology that seems instinctive, Shakespeare plumbed the depths of human passion and emotion, and made the drama for ever the crowning glory of literature.

And last, when his victory over the world was won, and he had severed his active connection with the stage and had retired to Stratford-on-Avon, the poet—seeking apparently to please himself by expressing his latest mood—wrote several plays that tell of the evening of life, in a spirit of placidity and forgiveness.

We have now to show how the plays written partly or wholly by Shakespeare group themselves in accordance with the four periods of development just indicated.

The first period saw the production of about one-third of the plays, some, however, being re-written later. Three comedies—*Love's Labour's Lost*, *The Comedy of Errors*, and *Two Gentlemen of Verona*—may be grouped as the earliest original flight, though simultaneously with the writing of them revision of historical plays was going on.

Shakespeare had lived in London four or five years when *Love's Labour's Lost* was written. The least observant reader cannot fail to notice the difference between its style and that of plays written ten years later. Blank verse, very regular in its beat, is only used for the most dignified speeches. The ordinary interchanges of talk are in rhyme. The broad comedy is in prose, a custom to which Shakespeare adhered in later years, when he had discarded rhyme jingles, and completely changed the monotony of his blank verse. The slight plot is apparently Shakespeare's own, and not appropriated—according to his general custom. The play satirises, lightly but pungently, certain social features and fashions of the age, especially the overbearing pretences that would "climb o'er the house to unlock the little gate." But it is all on the surface. There is no undercurrent of reflection even in the country songs that bring the play to an end. "When icicles hang by the wall" is only description—description with the fidelity of a Dutch picture, but nothing more, unless the poet designed a contrast with the artificiality of the society seen in the play.

The Comedy of Errors is a bustling farce of mistaken identity derived from the plots of two Latin plays, but in the picture of Ægeon, the Syracusan merchant, whose misfortunes give the play a semi-tragical foundation, there is promise of the Shakespeare of later years.

Romeo and Juliet

The Two Gentlemen of Verona is a story of intrigue suggested by the poet's reading of Italian tales. The rhyming habit has gone. The play included the lovely song, "Who is Silvia ?" and the much-quoted plea against the repression of youth's love-fancies.

The current, that with gentle murmur glides,
Thou know'st, being stopped, impatiently doth rage;
But, when his fair course is not hinderéd,
He makes sweet music with the enamelled stones,
Giving a gentle kiss to every sedge
He overtaketh in his pilgrimage;
And so by many winding nooks he strays
With willing sport to the wild oceán.
Then, let me go, and hinder not my course.
I'll be as patient as a gentle stream,
And make a pastime of each weary step,
Till the last step hath brought me to my love.

It is not from these early comedies that we can get a true idea of the possibilities of Shakespeare when he began his career as a dramatist. They are bright, but with a somewhat tinselled brightness. But about the same time when he was writing them, he was also writing his first Tragedy, *Romeo and Juliet*. The date of production is not

From the painting by Ford Madox Brown.

ROMEO AND JULIET

The tragic story of these two lovers was well known in the sixteenth century; it had already been told several times in prose and verse, but, as dramatised by Shakespeare (circa 1597), its action was so quickened and its feeling so intensified that it became once for all the world's most poetical and tragical expression of the fever of youthful love.

clear, for the play comes to us out of the mists of several revisions. The story had long been well known everywhere, but Shakespeare so quickened its action and intensified its feeling that he made it, once for all, the world's most poetical and tragical expression of the fever of youthful love. In it we see the impulsive passion of the South blossoming into full flower in a night.

The world's literatures tell no other story that sustains throughout the lyrical rapture of this fateful narrative. Palpably it is tricked out, here and there, in too gaudy colours, and has all the faults natural to exuberant youth, but it sweeps the spectator along irresistibly in the wake of impetuous love. After watching *Romeo and Juliet* no one could fail to be aware that a star of a brightness hitherto unknown had arisen in the dramatic and literary firmament.

Jealous Rivals

During the period between 1591 and 1593 the poet was not only busy with the three Comedies that have been mentioned, and with *Romeo and Juliet*, but also with historical revivals and new historical plays. To this time belongs the revision of the First Part of *Henry VI.*, an old play that probably passed through the hands of both Marlowe and Shakespeare. The scene in the Second Act, when the white and red roses are plucked in the Temple Gardens, and the death of Talbot in the Fourth Act are generally accepted as written by Shakespeare. The Second Part of *Henry VI.*, originally *The Contention betwixt the famous Houses of York and Lancaster*, may have been written by Marlowe and Greene, and certainly was revised by Shakespeare. The Third Part, originally called *The True Tragedy of Richard Duke of York*, was possibly drafted from an older play by Marlowe and Shakespeare, and finally was revised by Shakespeare alone, so as to lead up to his powerful original play of *Richard III.*

It was the closing Part of *Henry VI.* that called forth Robert Greene's jealous outburst on behalf of the professional playwrights against Shakespeare, as "an upstart crow, beautified with our feathers, that, with his *tiger's heart wrapped in a player's hide*, supposes he can bumbast out a blank verse as the best of you, and being an absolute Johannes factotum is in his own conceit the only Shake-scene in a country." The italicised line was a sneering distortion of a line by Shakespeare.

Greene's attack was published in the autumn of 1592, and before the year was out the printer, Henry Chettle, had apologised heartily. "I am sorry as if the original fault had been my fault, because myself have seen his demeanour no less civil than he is excellent in the quality he professes, besides, divers of worship have reported his uprightness of dealing, which argues his honesty, and his facetious grace in writing that approves his art."

Here then, using old plays as a groundwork, and basing his history largely on Holinshed's *Chronicle*, we see Shakespeare, the player-poet, taking precedence as a dramatist of the men trained in the wild school of the "University Wits," though for some time yet he will be under the literary influence of the forceful and tempestuous Marlowe.

Richard III., one of the best-acting, because most compact, of Shakespeare's plays, lastingly popular, though with a gloomy power, was planned in the Marlowe manner to centre all interest upon one figure that represents a single dominant impulse. The impulse in this case is unscrupulous ambition. The view of Richard's character adopted and developed is that of Sir Thomas More, in his Life of the last Yorkist King.

Historical Drama

Richard III. was followed by *Richard II.*, a play suggested, so far as its theme was concerned—a weak nature unequal to the stress of kingship—by the *Edward II.* of Marlowe. In Shakespeare's study of Richard's irresolution we see the first clear signs of the marvellous insight into complex character that later was illustrated so wonderfully in *Hamlet* and other tragedies. Here, too, in the character of John of Gaunt, Shakespeare struck firmly the vibrant note of English patriotism that rang through later plays, and ever since has echoed along the heart-strings of our race.

Two other plays with an historical atmosphere must be mentioned before we close the first Shakespearean period, which, however, has already passed far beyond the stage of apprenticeship to high achievement, though not to the highest. These plays are *Titus Andronicus* and *King John*. Both were adaptations of other men's work. *Andronicus*, though so gruesomely sanguinary, was very popular in Elizabethan times. Possibly Kyd wrote the original version, and Shakespeare gave it some finishing touches. A very bald play, *The Troublesome Reign of King John*, was made the basis of a play of great vigour, with the strain of English pride appearing strongly in it in the character of Falconbridge.

J. D.

Continued from page 13.

HISTORY

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THE FEUDAL SYSTEM IN EUROPE

In the simple polity of those Teutonic states, from which sprang the Barba ian conquerors of Rome, may be found the basis of that intricate edifice of political and territorial organisation known as Feudalism.

Tacitus's historic account of the manners and customs of "Germania" contains little or no suggestion of that social system which for many hundreds of years was destined to give such order, justice and method as was vouchsafed to mediæval European civilisation. The Roman historian shows us the infant nations of Europe, composed of free and independent tribes, whose occupations were mainly hunting and pasturage, who elected their kings from particular families, and who submitted the decision of all leading questions to a popular assembly.

Land and Power

The descent of these tribes upon the Roman Empire brought them rich conquests of land. This land they divided between themselves and the original proprietors. The lands were held mostly on allodial tenure, that is to say, were freehold and subject to no obligations save military service in the public defence. The inequality in the partition of these estates gave rise to a new landed aristocracy.

After the invasion of Gaul by the Franks, the kingdom of Clovis (*see* Vol. I., p. 265) was divided into a number of districts, and a "Count" was appointed for the government of each. His duty was to administer justice, collect the royal revenues, and lead the territorial army into the field. Dukes were also appointed with authority over several counties. These nobles gradually usurped power, and the inequality which existed in the original partition of estates was increased by personal rapacity and royal munificence.

Large tracts of land were reserved to the crown, and these were often granted out to nobles with military obligations to the sovereign. Such grants were, in the first instance, limited to the life of the holder.

So early as the days of Pepin and Charlemagne there arose the practice of subinfeudation, i.e. the splitting up of estates among lesser proprietors, who were subject to the same oath of fidelity and the same obligation of military service towards their overlord as he owed to the king.

The process by which the original allodial proprietors became gradually dependent on the great nobles was simple and inevitable.

After the decline of the Merovingian kings in France, the nobles usurped civil authority with a ruthless hand. In Germany the hereditary principle became universally acknowledged. In Italy the nobles established their independence. Authority tended to flow into the hands of powerful and wealthy proprietors, so that the small landholder had only one course open to him. He was obliged to save himself from complete extinction, and to guarantee his own security, by committing himself to the protection of some great noble.

Independence *versus* Safety

During the tenth and eleventh centuries in France, and indeed throughout Europe, we notice the gradual elimination of the freeholder, who relinquishes his independence to save his skin.

This process of *commendation* ensured the growth and vitality of the feudal system in Europe. It implied the oath of fealty to the overlord, and usually the obligation of military service, and an early relationship in which protection was ensured by the payment of a stipulated sum of money gave way to a condition of complete feudal dependence.

The hold of feudalism—in the strictest sense of the word—was weaker probably in England than anywhere else in Europe; and as the twelfth century wore on the powers and functions of the great feudal houses were rapidly usurped by administrative, as

opposed to territorial, families—families such as the Fitzwalters: often of commercial origin.

In every country of Europe the feudal system is distinguished by different characteristics, though one great principle underlies them all. The incidental features, despite differences of local custom, are marked by a striking similarity, and it is possible, therefore, to take a broad survey of the influence of feudalism during the centuries when it was the basis of the military and civil system of Europe.

To the possession of a fief was usually united local judicial powers. The lord retained to himself the right of meting out justice to his tenants. The contract between himself and his vassal was one of mutual fidelity and allegiance. If any of its terms were broken it was theoretically annulled, and the offending party forfeited his rights.

Obligations of Tenure

A ceremonial attached to the conferring of a fief, the vassal being required to take the oaths of fealty and to do homage, which was followed by the act of investiture. He then became liable to certain burdens of tenure, which may be summarised as follows :

1. *Reliefs.*—On taking a fief by descent, the heir, if of age, had to pay a fine called a Relief. This impost gave rise to considerable exactions, and in England the early Norman kings often obliged the heir in effect to purchase or redeem his lands. Henry I. promised that these reliefs should be fair and reasonable, and in Magna Carta the rate was finally laid down as £100 for a barony and 100 shillings for a knight's fee.

Fixed reliefs were among the old customs of Normandy. If the heir could not pay the relief, the lord was entitled to hold the lands for a year, a principle established by a law of St. Louis in 1245, which makes its appearance in England under the name of *Primer Seisin.* This legal custom established the right of the king, on the death of one of his tenants, who had an heir of full age, to claim a year's profits of the land. It is, in this relation, interesting to notice the analogous practice of the Popes in exacting the first fruits of a benefice from the clergy.

2. *Fines upon Alienation.*—The feudal contract could not be dissolved without the consent of both contracting parties. The power of the vassal to devise his land by will, or in his lifetime, varies in different ages and countries. A law of Lothair II. in Italy forbids the alienation of the feud without the lord's consent. By a law of France the lord was entitled, upon every alienation made by his tenant, either to redeem the fief by paying the purchase money or to claim a certain part of the value by way of fine on a change of tenancy. The right of devising land by will practically ceased in England at the Norman Conquest.

Indirectly, alienations of fiefs, through sub-infeudations, was practised, but by the Statute of *Quia Emptores* (18 Edw. I. c. 1) sub-infeudation was forbidden, and every freeman was allowed to devise his land at will, to be held, not of himself but of his lord. The alienation of land by tenants who held it directly from the king was allowed only by licence up till the time of Edward III., when it was permitted without licence on payment of a reasonable fine.

3. *Escheat and Forfeiture.*—If the tenant of the land died intestate, or if he was convicted of felony or treason, the land reverted to the lord by whom it was originally granted. In England the king had the right of forfeiture of the lands of a felon convicted of treason, and forfeiture for a year and a day in the case of other felonies. This forfeiture overstepped any claims of the intermediary suzerain

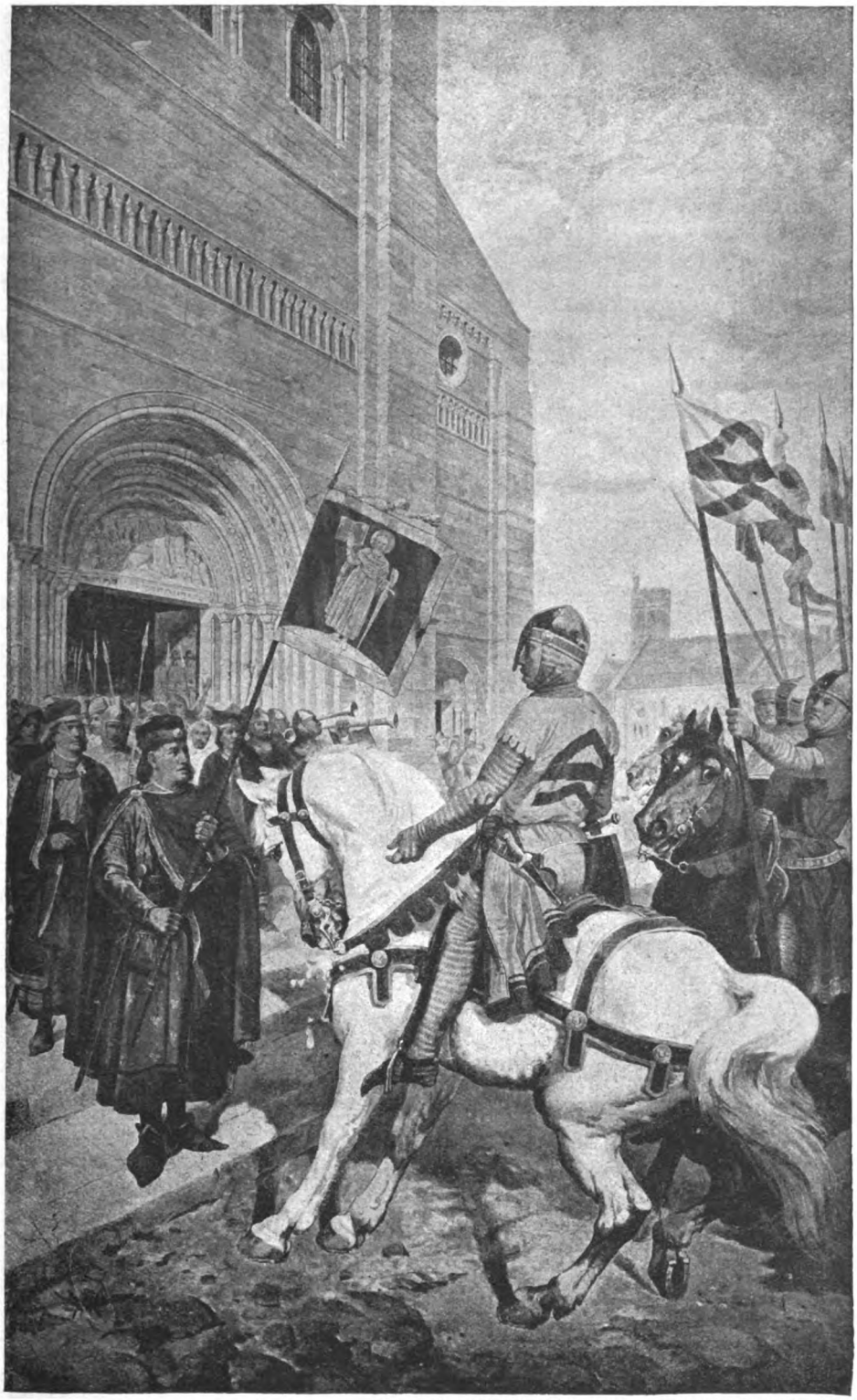
Rights of the Lord

4. *Aids.*—The right of the mesne lord to call upon his tenant for aids on special occasions varies according to local customs. It became, however, very generally established throughout Europe that the tenant was obliged—(*a*) to aid in the ransom of the lord's person from prison ; (*b*) to aid in the making of his eldest son a knight ; and (*c*) to aid in providing the dowry of his eldest daughter on marriage.

A law of William I. in Sicily restricted the aids to nearly the same description, and they were also thus established by the customs of France and by Magna Carta in England. The Statute of Westminster (3 Edw. I.) fixed the aid at 20 shillings for every knight's fee and for every £20 value in land.

5. *Wardship.* — In England and Normandy the mesne lord claimed the wardship of the tenant during his minority and was entitled " to the custody of his body and lands without any account of the profits." The heirs, on attaining their majority, were obliged to pay half a year's profits in lieu of all reliefs and primer seisins.

This privilege of wardship, which gave rise to many of the worst exactions of feudalism, was enjoyed in some parts of Germany, but was otherwise almost peculiar to Normandy and England. In France the care of the estates during the minority of the heir



From the painting by Richard Beavis, in the Guildhall, London.

Robert Fitzwalter, Castellan of London, in the Reign of Henry III. (1216-72), receiving the City's Banner from the Lord Mayor.

was entrusted to the next heir and the nearest kinsman who could not inherit.

6. *Marriage.* — The lord also possessed the right to tender a husband to his female wards, and the rejection on the part of the ward of the proffered husband involved the forfeiture of a sum of money equal to that which the suitor was willing to pay for the marriage. This right was afterwards extended to male heirs, and became a very lucrative source of extortion. Kings and lesser suzerains required that their consent should be given to the marriage of their vassals' daughters.

These feudal services distinguish the maturity of the system in the eleventh and twelfth centuries. They indicate the common obligations of territorial magnates to their superiors. But the system extended in many other directions.

Various Forms of Tenure

Forms of tenure other than those based purely on military obligation were early a common feature. Thus in England, before the Conquest, we find that the barons who were attached to the king's household, though themselves of high rank, thought it no mean honour to be the king's scullion or his *stallere*, a position very nearly approximating to that of the *comitatus* in Tacitus.

Tenure by Grand Serjeantry later implied a relationship of this character. The tenant of the king's land rendered service by carrying the king's banner or lance, or holding office in his household. The Count of Anjou, in the reign of Louis VI., held the office of Great Seneschal of France, and discharged his obligations by carrying dishes to the king's table on state occasions.

Tenure by Petit Serjeantry was common among the king's lesser servants, such as huntsmen, falconers, etc., to whom grants of land were made in respect of such services.

Tenure by Free Socage in England is contrasted with tenure by knight service, in so far that the obligations of the tenant were represented by certain definite services, such as the payment of rent in money or ploughing the lord's land for specified days in the year.

The whole question of the position of the lower orders under feudalism is a difficult and intricate one, and the phenomena vary in the different countries of Europe. In France every possessor of a fief was a gentleman, though the nobility of allodial tenure depended on the right to territorial jurisdiction. As the nobility established themselves by the adoption of surnames and armorial bearings, a broad line came to be drawn between the high-born and ignoble classes, which tended to become more distinct. Plebeians could acquire land by purchase, but they were under disabilities.

The lower orders may roughly be divided into freemen and villeins. Freemen included the citizens of towns which had had charters conferred upon them, tenants in free socage (in England). In French records all classes except those definitely holding feudal ranks tend to become confused in the villein class, though many free proprietors undoubtedly existed. Hallam quotes Beaumonoir as saying: "All who have the right to be called gentlemen are free, but all who are free are not gentlemen."

In Germany, as elsewhere, the enrichment of the noble class tended to the extinction of the freemen. Many sold themselves into slavery. A law of Charles the Bold, 864, authorises redemption at a fair price.

In England, besides tenure by free socage, we observe the same conditions of freedom existing amongst the inhabitants of chartered towns under the title of burgage—a free tenure implying fixed rents and services, in the first instance due only to the sovereign, but later to the noble to whom the town was granted.

Serfs and Villeins

The villein was very much restricted in his liberties. He was unable to leave his lord's estate or to sell the lands on which he dwelt, and his lords could reclaim his person if he left the manor. His state of servitude was that of an apprentice or hired servant. He held the land which was given to him in lieu of money wages.

The normal villein holding was a "virgate," i.e. about 30 acres. The holdings on an estate were worked together as one farm in conjunction with the lord's demesne. Indeed, an individual holding was rarely, if ever, a compact block of land; it consisted usually of a number of acre and half-acre strips scattered over the estate, strips being divided one from another by narrow "balks," or bands of unploughed turf.

In England there were two distinct classes of villeinage—pure and privileged. In the first, the tenant was bound to do whatever work the lord desired; in the second, his services were defined. The villein class, however, were in the position of complete subjection to their lord.

In France and Germany the same distinction between privileged villeinage and pure serfdom seems to have been drawn.

Enfranchisement sometimes came through

services in war, especially in Italy, where the number of those in bondage was considerably decreased by the twelfth century. In some parts of Germany many peasants had acquired their freedom by the end of the thirteenth century.

The right of coining money, of waging private war, of freedom from legislative control, and the right of exercising judicial power over the vassals were among the extensive privileges of the feudal aristocracy in France. A charter of Louis I. concedes to an individual owner the exclusive rights of jurisdiction over all persons resident in his territory. Military tenants, instead of taking their quarrels to the county court, came to seek justice from their overlord.

Feudalism and the Church

The right of jurisdiction varied from that of life and death to a lower jurisdiction, which was compelled to send capital cases to a higher tribunal. In England, before the Conquest, local judicial organisation centred round the manorial system, and the Conquest changed it but little, except that ecclesiastical courts were given exclusive jurisdiction in spiritual matters, and that in the shire and hundred courts the Norman vice-comes presided with extensive powers.

The relation of the Church to feudalism provides only another instance of the all-pervading qualities of the organisation. The archbishops, bishops and abbots were as powerful and bore the same relation to their tenants as the great feudal lords. They swore the same oath of fealty to the king, and their tenants swore fealty to them. Though the ecclesiastics may sometimes, though not always, have escaped the obligation of military service, their tenants were called upon in the same way as the tenants of any other noble. The prelates were endowed with the same rights and privileges.

A Stage in Human Progress

If we estimate feudalism as a stage of human progress, considering its inherent features and the broad influence which, for hundreds of years, it exerted on the affairs of men; it may be said that, with all the wrongs that through it were inflicted, it nurtured such progress and enlightenment as existed in the Middle Ages.

Feudalism in its broadest meaning represented civilisation. Here and there the cruelty of an overlord to his peasantry leaves a scar on the pages of its history, but it is in the direct influence of its system that we can trace much that is noblest in law, in the chivalry of arms, and in the pursuit of art and letters. J. A. B.

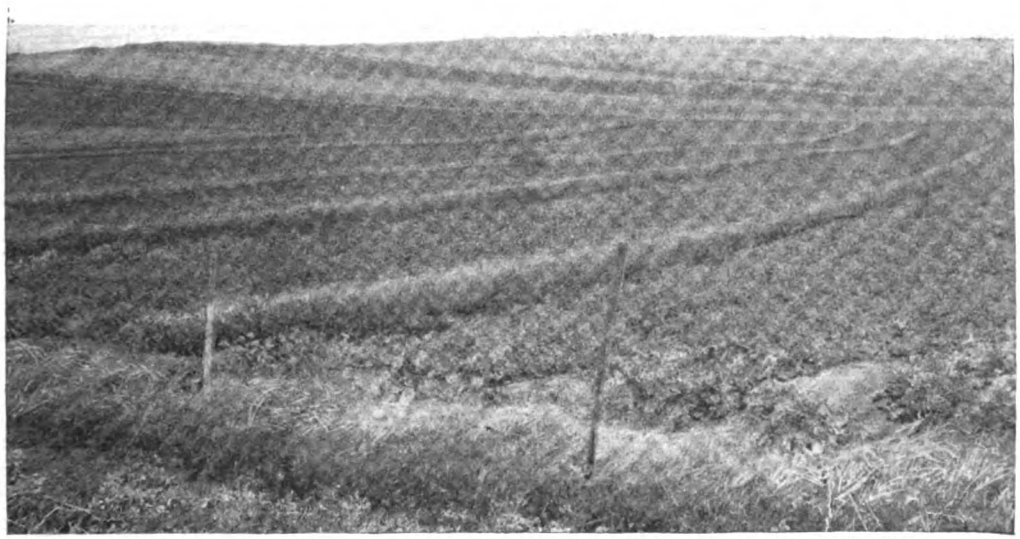


Photo: By permission of Miss E. M. Leonard.

A COMMON FIELD SHOWING DIVISION BY BALKS

or banks of unploughed turf—a survival of the feudal system of land tenure, traces of which can still be found in some parts of England—notably in Somerset and the Eastern Counties.

Continued from page 28.

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Contributors:—ANTHROPOLOGY AND ETHNOLOGY (Sir H. H. Johnston, G.C.M.G., K.C.B.). ASTRONOMY (Arthur R. Hinks, M.A., F.R.S.). BOTANY (E. W. Edmunds, M.A., B.Sc.[Lond.]). CHEMISTRY (E. H. Tripp, Ph.D.). ELECTRICITY AND MAGNETISM (L. M. Parsons, M.Sc., D.I.C., F.G.S.). GEOLOGY AND MINERALOGY (Arthur Holmes, D.Sc.[Lond.], A.R.C.S., D.I.C., F.G.S.). PHYSIOLOGY (Sir Malcolm Morris, K.C.V.O., and D. W. Carmalt-Jones, M.A., M.D.[Oxon.]). SOUND, LIGHT, AND HEAT (E. W. Edmunds, M.A., B.Sc.[Lond.]). ZOOLOGY (E. A. Bryant and Ashley G. Brown, F.Z.S.).

CHEMISTRY.—X

SINCE hydrogen and oxygen unite with such a display of force and energy, the question arises: Would hydrogen take away and combine with oxygen contained in oxides?

Experiment XXXV.—*To find the action of hydrogen upon heated metallic oxides.*

Some *dry* copper oxide is placed near the middle of a hard glass tube, about 15 cm. long, which is clamped in a horizontal position. At one end of the tube hydrogen enters. Instead of hydrogen, coal gas, which contains 50 per cent. of it in a free state, may be more conveniently employed. The other end of the tube may either terminate in a jet, from which the excess of gas is burnt, or it may be connected with a length of narrow glass-tubing also fixed horizontally. (Fig. 14.)

On gently warming the copper oxide in a current of gas, it is soon observed to change to a red colour: this is metallic copper. Also, drops of a liquid are seen to collect in the cooler part of the tube, or in its prolongation; if it be tested in the manner previously described, it is found to be pure water. The action can be summarised thus: Copper oxide + Hydrogen = Copper + Water.

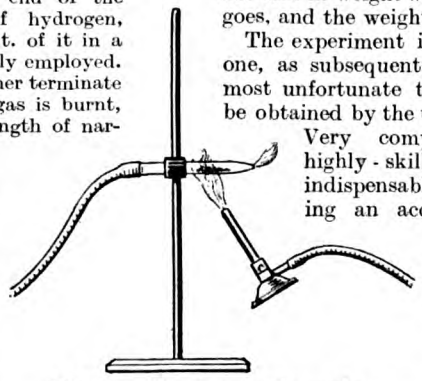


Fig. 14.—To observe the action of hydrogen on heated metallic oxides.

In a like manner it is found that hydrogen will deprive the oxides of lead and iron of their oxygen; but it has no action upon magnesium, tin, and aluminium oxides.

Such experiments illustrate the very important principles of reduction and oxidation. In the above reaction between hydrogen and copper oxide, since the former combines with oxygen, it is said to be "oxidised"; and as the oxide loses oxygen, it is said to be "reduced." Further, the hydrogen is called the "*reducing agent*" and the copper oxide the "*oxidising agent.*"

It will be noted that the oxidation of one form of matter implies the reduction of another; but in the case of the oxidation of a substance by combustion in the air, it is not customary to speak of the reduction of the air, because its oxygen is in the free state.

In a subsequent chapter we shall develop this elementary and preliminary conception of oxidation and reduction.

The reaction studied in the last experiment will now be made use of to ascertain the combining proportions of hydrogen and oxygen, and for this purpose it will be necessary to determine both the loss in weight which the copper oxide undergoes, and the weight of water formed.

The experiment is an exceedingly important one, as subsequent study will show, and it is most unfortunate that accurate results cannot be obtained by the use of elementary apparatus. Very complex apparatus and a highly-skilled experimenter are the indispensable conditions for obtaining an accurate result. Such complex apparatus can be typified by the simple pieces placed together in the figure.

Experiment XXXVI.—*To ascertain the composition of water by weight.*

The hydrogen is generated by the action of dilute sulphuric acid upon zinc, and being moist and very impure, it must be purified and dried by passing it through a number of U-tubes containing purifying and drying agents. In Fig. 15, the first tube contains caustic potash, which combines with acid gases and some moisture, and the second is filled with calcium chloride, which further dries the gas. In accurate work, phosphoric oxide must be used as the drying agent.

The copper oxide must be pure, and before use completely dried by ignition. It may be weighed out either in a small porcelain boat, which is then inserted in a hard glass tube to be heated, or it may be directly weighed in a bulb-tube made of hard glass.

The water formed by the reduction of the copper oxide is driven by the hydrogen into a series of U-tubes containing a drying-agent. These are weighed both before and after the experiment, the gain in weight giving the weight of water formed. From this is subtracted the loss in weight of the copper oxide, i.e. the weight of the oxygen, and the difference will give the weight of hydrogen which united with that oxygen.

As the reduced copper tends to retain hydrogen with great obstinacy, it must be heated to a high temperature before it is cooled.

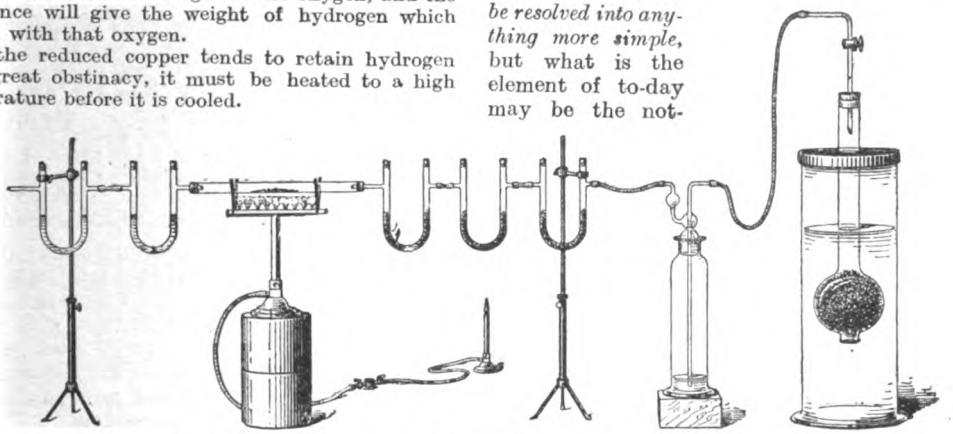


Fig. 15.—To ascertain the composition of water by weight.

To take an ideal example :—

Weight of tube and copper oxide before reduction	18·247 g.
Weight of tube and copper after reduction	17·709 g.
Loss (oxygen)	0·538 g.
Weight of calcium-chloride U-tubes after the experiment	31·341 g.
Weight of calcium-chloride U-tubes before the experiment	30·736 g.
gain (water) ..	0·605 g.

Weight of water formed = 0·605 g.
Weight of oxygen in the water = 0·538 g.

Weight of hydrogen = 0·067 g.

Since 0·067 g. of hydrogen combined with 0·538 g. of oxgyen ; therefore 1 g. of hydrogen combines with $\frac{0{\cdot}538}{0{\cdot}067}$ g. of oxygen = 8·03.

The most accurate experiments give 7·94 parts by weight of oxygen to one part by weight of hydrogen. For ordinary purposes the round number 8 may nearly always be employed.

Classification of Substances.—Our study of air and water has familiarised us with many aspects of chemical change. We have learnt how some substances unite to form something new, and how other substances are decomposed into something more simple. Nevertheless there are limits to both kinds of change. Hydrogen and oxygen only combine in a fixed ratio : copper and nitrogen do not combine at all.

The application of heat, electricity, light, mechanical work will result in the decomposition of many substances composed of two or more constituents ; but the limits of chemical decomposition are soon reached. Oxygen, nitrogen, hydrogen, chlorine, sulphur, phosphorous, iron, copper, silver, gold, etc., have up to the present defied all efforts to separate them into two or more simpler substances.

On this account they are called *elements*.

An element then is a form of matter which, so far as we know, cannot be resolved into anything more simple, but what is the element of to-day may be the not-element of to-morrow. Of the 83 elements that are known with certainty, the majority are metallic in character, and the greater number of them neither occur free in nature nor exist in any considerable quantity.

Oxygen is by far the most abundant of them, comprising about one-half of the crust of the earth, including the air and the water. Silicon, which occurs largely in rocks and as oxide in the forms of sand, flint, quartz, etc., ranks second, and the most abundant metal is aluminium, a constituent of granite, clays, etc., followed by iron.

Any substance which is capable of separation into two or more distinct substances, may be termed a Not-element. Thus air can be resolved into nitrogen and oxygen (principally), and water into hydrogen and oxygen ; but there is a very great difference in the manner in which the constituents of air and water are respectively associated. A sample of air can be made by *mixing* oxygen and nitrogen in the correct proportion, but no amount of mixing will convert oxygen and hydrogen into water, chemical change alone can effect the transformation.

The air is an example of a *mixture ;* water, that of a *compound*. The properties, i.e. qualities, of air are roughly the average of the properties of its two principal ingredients, but those of hydrogen oxide bear practically no resemblance to oxygen and hydrogen. In air, the nitrogen and oxygen retain their individualities, but in water, the oxygen and hydrogen lose theirs completely.

Again, it is possible to separate the atmospheric gases by such processes as solution and diffusion, but water can only be split into its component elements by chemical action. A compound possesses fixed physical constants, such as density, melting-point and boiling-point.

Pure water always freezes at 0° C., and boils at 100° C. (under normal pressure), but when air is converted into liquid by the application of

cold and pressure, the "liquid air" produced has no constant density or boiling-point, as the nitrogen boils off first and the oxygen afterwards, the temperature rising all the time.

The final and most important distinction between mixtures and compounds is that the relative weights of the constituents of the former may vary in all proportions, they never do so in the latter. Accurate determinations show that although the proportions of oxygen and nitrogen in air are nearly constant, yet there is a variation within small limits, but pure water always contains its hydrogen and oxygen in the ratio of 1 : 8 by weight, and this is the case whatever be the source of the water, and in whatever way it be analysed. And what is true of hydrogen oxide is true of *all* compounds without exception; their composition is absolutely fixed and definite.

This great truth is commonly known as the *Law of Constant Composition*, or as the *Law of Fixed Proportions*. It is of such importance that the student must seek to illustrate it experimentally, "illustrate," not "prove," because a proof would require an enormous amount of labour of a very skilled kind, far superior to that which an elementary student can command.

Experiment XXXVII.—*The Composition of Magnesium Oxide.*

In Experiment VII. (Lesson III.), we found that when magnesium is burnt in air, 1 part by weight of it combines with 0·6 parts of oxygen. We shall now convert the metal into the oxide by a totally different process and endeavour to obtain the same result. Instead of oxidising with atmospheric oxygen, we shall use nitric acid, one of the best of oxidising agents.

A small crucible and lid are cleaned, dried and weighed. About 15 cm. of magnesium ribbon are also weighed, then broken into small pieces and put in the crucible. Diluted nitric acid (about 2 of acid to 3 of water) is then put on to the metal, drop by drop, and when the action is nearly finished a little heating will effect complete solution. If the action gets violent the lid must immediately be put on the crucible. The red fumes which escape are a mixture of oxides of nitrogen: the liquid in the crucible contains magnesium nitrate dissolved in a slight excess of dilute nitric acid.

This liquid is very carefully evaporated to dryness, and the white residue, magnesium nitrate, heated at first gently, then strongly, until no further change is apparent. The final residue, magnesium oxide, is weighed in the crucible, and then a simple calculation gives the weight of oxygen which combines with 1 gram of metal. The result should be in close accordance with that stated above, thus showing that magnesium oxide is produced by the combination of magnesium and oxygen in a definite proportion by weight.

There are many cases known of elements combining in more than one proportion, to form more than one compound. Thus there are two oxides of copper; the black one, we already know, called cupric oxide, and a red one called cuprous oxide; and each of these compounds has of course a fixed composition. It will be interesting to find out the proportional weights of copper and oxygen in each case.

Experiment XXXVIII. — *The Analysis of Cupric and Cuprous Oxides.*

To obtain accurate results in this experiment, it is important that dry, pure materials only should be used. The reaction to be used has already been studied; it is given by the equation, copper oxide + hydrogen = copper + water. The experiments are conducted in precisely the same way as explained for Experiment XXXIII., only now the tubes and contents have to be weighed before and after the actions have taken place, both oxides being heated in exactly the same manner.

Accurate determinations show that in cupric oxide there is 1 part of copper to 0·127 parts of oxygen, and in cuprous oxide 1 of copper to 0·063 parts of oxygen. It is not difficult to see that the proportion of oxygen in the former is just double that in the latter.

The oxides of iron and of lead may be analysed similarly, and it will be found that the weights of metal (or of oxygen) which unite with a fixed weight of oxygen (or metal) stand in some simple numerical relation to one another.

Such results illustrate the important second Law of Chemical Combination, called the *Law of Multiple Proportions*:—

When two elements combine to form more than one compound, the weights of either one of them which unite with a fixed weight of the other, are in a simple numerical ratio.

The ratio is not always 2 : 1, but sometimes 2 : 3 or 3 : 4 or 1 : 3; but in every case it can be expressed by small whole numbers. E. H. T.

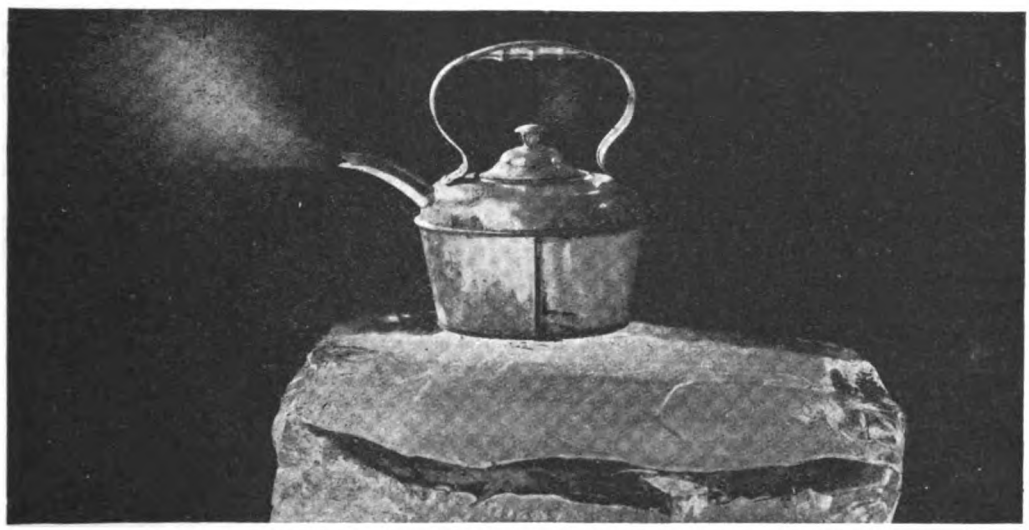
HEAT.—IX

39. Liquefaction of Gases.—We have seen that liquids give off more or less vapour at all temperatures, and that the amount of evaporation depends on the two factors—saturation and temperature. We have also seen that the vapour returns to the liquid form either when it is subjected to increased pressure, or when it is cooled. Now, a substance which in its ordinary manifestation is a gas is no more than the vapour of a liquid which can only exist at a very low temperature. Faraday was one of the earliest scientists to test this matter by experiment, and he found that all the gases known to him except six could be liquefied under suitably large pressures. Among these gases which can be thus liquefied at ordinary temperatures are chlorine, ammonia and carbonic acid gas; those which could not were described as permanent gases and include hydrogen, oxygen, nitrogen, and, of course, air. All attempts to liquefy these gases by great pressures failed.

The reason for this failure was discovered by Dr. Andrews, of Belfast, in 1869. He discovered that for every gas there was a temperature, called the *critical temperature*, above which the gas was a true gas and could not be liquefied by pressure alone, and below which it acted as a vapour and could be liquefied by sufficient pressure. The critical temperature of carbonic acid gas, for example, is about 31°. Above this temperature no pressure will liquefy it, whereas at 15° the gas becomes liquid

when a pressure of 50 atmospheres is applied to it. Hence, if the "permanent" gases are cooled below their critical temperature, we may expect that they too will yield to sufficient pressure. The problem therefore reduces itself to discovering a means of obtaining the very low critical temperatures of these gases (—130° for oxygen and —238° for hydrogen). This was first accomplished by Pictet of Geneva, and Cailletet, of Paris, in 1877.

If liquid carbonic acid is allowed to evaporate at a low pressure, intense cold is produced, but even this is not quite sufficient to liquefy air. Suppose, however, air which is thus cooled under a great pressure is suddenly permitted to expand: another source of cold is introduced. For the gas, in the process of expanding, does work in overcoming the mutual attraction of its molecules, and the energy for this expansion is taken from the molecules themselves. In other words the expanding air draws on its own store of energy—i.e. upon its heat—and is cooled. This is the principle of the method by which air was first liquefied. It was first cooled as much as possible by being led under pressure through a tube cooled by the evaporation of liquid carbonic acid; and in this cooled condition it was allowed to cool itself further by "free" expansion. The result was to bring it well below its critical temperature, and thus to make it possible to liquefy it. By great improvements in the apparatus used, Dewar and others have shown us that hydrogen may be liquefied, and temperatures have been reached not many degrees removed from the absolute zero. Further, liquid air and liquid hydrogen can be frozen if they are allowed to boil rapidly at a reduced pressure, the heat necessary for evaporation being taken from the liquid itself and thus freezing that which remains. Liquid hydrogen boils about —253° C., and freezes at —257°.



Air can exist in its liquid state only at a temperature so intensely low that a kettle of it placed on ice would immediately boil.

40. Hygrometry.—In its ordinary condition, the air is not usually saturated with water vapour, but there is always some vapour present which becomes apparent when the air is cooled. For at low temperatures it requires less vapour to saturate the air than at higher temperatures; hence, cooling the air will ultimately bring it to its saturation-point. The temperature at which the air becomes saturated with the moisture it has at present is called the *dew-point*; and obviously, if we know the dew-point, we have a good idea of the wetness or dryness of the air at the time. Thus, suppose the temperature of the air on any given day to be 20° C., and the dew-point to be 12° C. At 20° the maximum pressure of water vapour is 17.39 *mm.*; at 12° it is 10.46 *mm.* The pressure of water vapour on the given day is therefore only 10.46 *mm*, while it might be 17.39 *mm.* Hence the air contains only $\frac{10.46}{17.39}$, or ·602, of its possible amount of water-vapour. This number, or ratio, is known as the *relative humidity* of the air; in the given case, it shows us that the air is little more than half saturated with water-vapour. If by any means, however, the air were cooled below 12°, it would be quite saturated, and a mist begin to fall.

To determine the relative humidity is a very useful assistance in weather forecasting, and it clearly involves some method of determining the dew-point by observation. The relative humidity can then be found by reference to tables which show the pressure of aqueous vapour at different temperatures.

Instruments for finding the dew-point are called *hygrometers*, and several forms are in use. They all depend upon some means of local cooling of the air, until it deposits mist.

In *Daniell's hygrometer* (Fig. 53), we have two bulbs, A B, each containing ether, and connected by a tube, the whole being exhausted of air. A has on the outside of it a strip of polished gilt, and a small thermometer inside it dips into the ether.

A piece of muslin saturated with ether is fastened on to the outside of B, when the instrument is being used. This ether rapidly evaporates, and thus cools B. The result of this cooling is the condensation of some of the ether-vapour in B. Some of the ether in A then evaporates to make this good, and the bulb A is therefore cooled in its turn. As long as B is kept continuously cooled, the evaporation goes on in A; the air around A becomes cooler, and when the dew-point is reached the surface of the gilt strip is seen to be dimmed by a mist. Read the temperature from the thermometer in A, which gives the dew-point required. The result should be checked by watching the temperature at which the mist disappears when the muslin is taken off B. The two temperatures ought to be the same; if they are not, the average of the two should be taken.

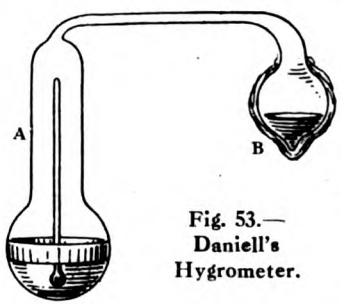


Fig. 53.—Daniell's Hygrometer.

Regnault's hygrometer is even simpler. It is composed of a glass tube, on which a thin silver thimble is fixed (Fig. 54). The test-tube thus formed is closed by a three-holed cork, fitted with a thermometer and glass tubes as shown in the figure. In the silver cup a little ether is placed, and air is blown through this until mist appears on the silver. Note the temperatures when the mist forms and when it disappears, and obtain the dew-point as with Daniell's hygrometer.

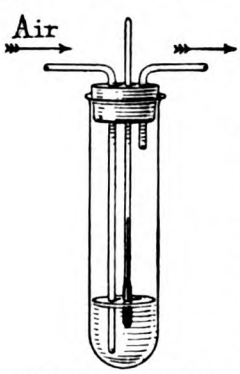


Fig. 54.—Regnault's Hygrometer.

In *Dines' hygrometer* a piece of black glass is cooled by a current of ice-cold water, a thermometer being so placed that its bulb is in contact with the glass. The mist is observed as before (Fig. 56).

Several substances are hygroscopic, i.e. responsive to a wet condition of the air. Human hair is shorter when it is damp, and sea-weed swells visibly in a damp air. Catgut is used in the construction of the "old man and woman" rain predictors, because it responds to the hygrometric condition of the air. Many chemicals such as calcium chloride and magnesium chloride (which sometimes occurs in household salt) are very hygroscopic. Cobalt chloride, which is blue when dry, becomes pink when moist.

If two thermometers are kept side by side, and the bulb of one of them is kept persistently wet the temperature of this thermometer will fall—the more if the air is dry and there is much evaporation. Unfortunately the temperature given by the wet bulb thermometer is not the dew-point, and special tables have to be employed in order to calculate the dew-point from observation of the two thermometers. Nevertheless the two thermometers give us valuable indications of the hygrometric state of the air; and if the student will plot the readings obtained during a month and compare them with the state of the weather, he will the better realise their value.

41. Mists, Clouds, Rain.—When the air is cooled below the dew-point, the water-vapour in it becomes visible in the form of small drops of liquid water. A *mist* is thus formed; but careful observation has shown that mist does not usually form, even in saturated air, unless there are dust-particles in it to act as nuclei of condensation. Without the dust, the air will remain supersaturated many degrees below the dew-point. The dust particles help to keep the particles of water floating in the air for a very long time; but sometimes, as in a Scotch mist, the droplets of water become so big as to subside as soon as they are formed. There is then no visible mist, though every object out-of-doors rapidly becomes wet.

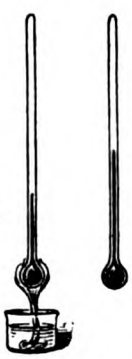


Fig. 55.

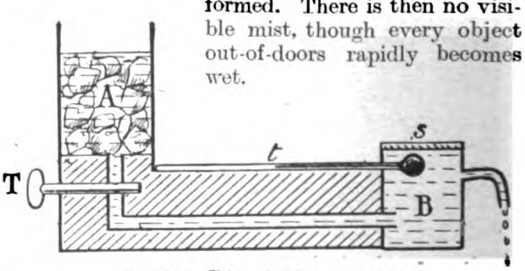
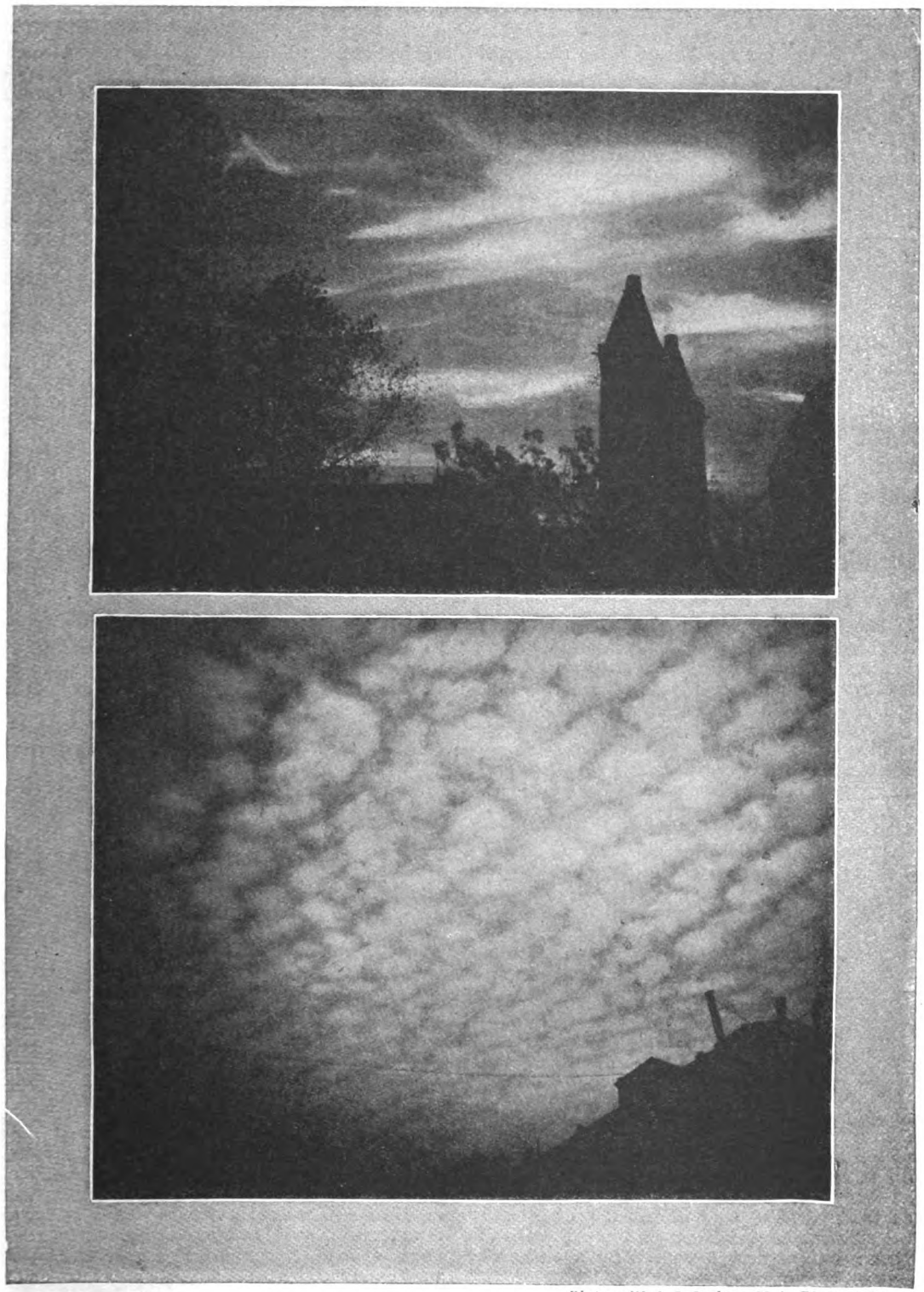


Fig. 56.—Dines' Hygrometer.

A, B, chambers containing ice cold water; T, tap; *t*, thermometer in groove of wood; *s*, plate of silver or black glass.

A *cloud* is a mist elevated above the earth's surface, and the different forms of clouds are due to the different conditions under which the air cools. The *stratus cloud*, for example, arises, like a mist, from the general cooling of a mass of air *in situ*—a cooling which naturally occurs as night falls. The *cumulus cloud*, the rolling cloud-masses seen most frequently when the air is violently disturbed, is due to the sudden condensation produced, when a mass of heated and saturated air is carried upward and suddenly mixed with a colder layer of air. The cloud from a locomotive is similar in its formation to this. The *cirrus cloud*, the light wispy cloud formed at high elevations, has a different origin. As air rises to very great heights, it, of course, rises into regions of lower and lower pressure; consequently, following Boyle's law, it expands, and in so doing loses heat. The cold produced in this way is sufficient, at very great heights, to freeze the condensing vapour, and we have good evidence for thinking that cirrus clouds consist of ice-particles. The various types of cloud studied by meteorologists



Photos: W. J. S. Lockyer, M.A., Ph.D., F.R.A.S.

CIRRUS (*top*) AND ALTO-CUMULUS (*bottom*) CLOUDS.

Cirrus Clouds, fibrous and feathery, and found always at great heights, consist probably of ice particles: Alto-Cumulus Clouds are moderately large globular masses, white or greyish, arranged commonly in groups.

suggest fascinating questions for the student of heat also.

A *fog* is formed when cold air and hot saturated air mingle; or, very commonly in autumn, when a current of warm air from the south-west passes over the cold air near the ground. The warm air, being saturated, loses some of its vapour as it mixes with the colder air below it. The great density of fogs in large towns is mainly due, doubtless, to the number and size of the dust particles there.

Photo: T. C. Hepworth.

CUMULUS CLOUD.

typical of the great rolling masses seen when the air is violently disturbed.

How the drops of water in a cloud turn into *rain* it is not easy to say, and the exact method of formation of *hail* is still more uncertain. But a drop of water, passing through saturated air, is relatively cool, and more water would tend to condense on it, thus forming a larger drop. And if such a drop were carried by violent winds into a stratum below 0°, it would freeze into a simple drop of ice. A hailstone, however, often shows evidence of several alternations of freezing and partial thawing, and its formation does not take place, except in disturbed conditions of the atmosphere.

42. Spheroidal State of Water.—When a little water is dropped on to a white-hot metal plate, it does not immediately boil, nor does it spread out over the plate, but it rolls about in little spherical drops. In this condition it will remain as long as the plate remains white-hot. This is known as the *spheroidal state* of water. It can easily be observed that the water does not *touch* the plate: it is separated from it by a cushion of its own vapour, thick enough to prevent the water from rising to its boiling point. When the temperature of the plate is diminished, the vapour-cushion becomes thinner, and enough heat can be passed across it to boil the water and the drop breaks up. If such a drop be placed in a white-hot platinum crucible, and a little liquid carbonic acid be then added, the drop of water can be frozen in the white-hot crucible, the rapid evaporation of the carbonic acid producing the necessary cold. The protective influence of such a vapour-cushion is also seen, when the moistened hand is plunged unhurt into molten lead, or when a laundress licks a red-hot iron.

Town Fogs.—The peculiarity of town fogs is their persistence—a circumstance due, as is well known, to the fact that they are not made up of pure vapour, but are often composed of various deleterious substances. Sulphur, carbon, and ammonia are the things most commonly found when a sample of town air during foggy weather is analysed, and since such particles appear in myriads they attract moisture to themselves, and so give an opaqueness to the fog.

Clouds, rain, dew, hoar-frost, and fog cannot spring into being unless there is first of all a dusty nucleus upon which the condensing moisture can settle. Indeed, if it were not for these dusty atoms rain would be perpetually falling on the earth, but since they are everywhere present they serve as resting-places for the vapour, and so keep it buoyed up in the air.

From time to time experiments have been made with the view of determining the chemical composition of a London fog. Carbonic acid enters very largely into its composition. In the City of London on an ordinary day the amount of carbonic acid in the air is not above four parts in 10,000 of air. During fogs it is very much higher. Thus on one occasion the amount of carbonic acid in London went up to the high figure of 14·1, about three and a half times as much. Built up very largely of carbon and sulphur substances which come from coal, fogs are caused chiefly by domestic fires, rather than by factory chimneys. It has been said that this is why town fogs are more prevalent at Christmas than at any other time of the year! E. W. E.

Photo: T. C. Hepworth.

CUMULUS CLOUD

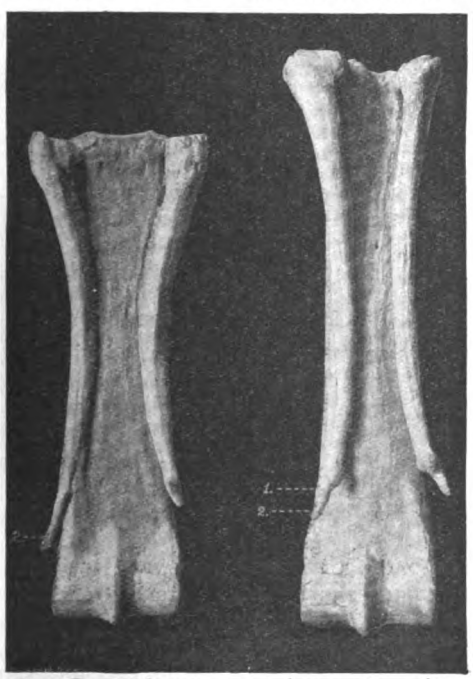
as seen with light shining behind. In the other photograph on this page the cloud is seen with the light in front.

ZOOLOGY.—IX*

To the zoologist the ungulata or hoofed mammals represent a turn in the tide of life and world conditions somewhat resembling that implied by the flight of the dove which returned not again to the ark.

Hoofed Mammals

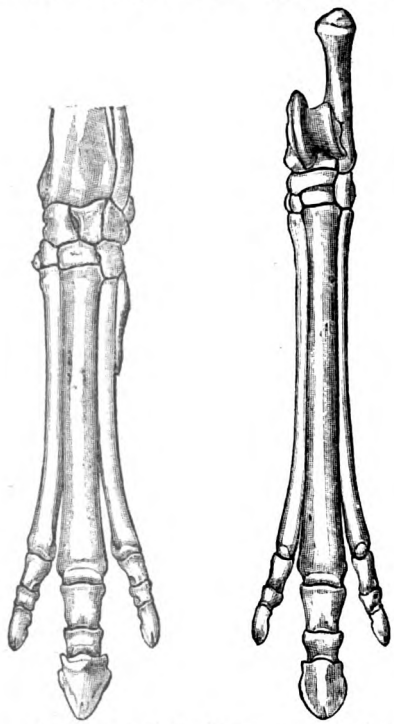
Dry land, rising above the flood, afforded a resting place in freedom for the bird. Dry land, emerging from swamp and marsh, became plain and prairie, generous with grass and other herbage suitable as food for such animals as could march and claim it. The ponderous beasts which had wallowed in the mire of ancient earth were not adapted to take full advantage of the new circumstances. Paws and claws, supple and spreading, served for support in an environment of marsh, but for hard firm surfaces a different form of foot became necessary. So hoofs, or toes firmly enclosed and furnished with broad, powerful flattened nails, came slowly into being, correlated with a form of dentition



For Comparison: cannon-bones of a shire horse and—

adapted to life in rich pastures. Such, stated in the most elementary terms, is the zoological explanation of the slow rise of the ungulates.

The order includes animals of the most diverse shape, size and habit, yet its members fall into four great groups: the elephants; the hyraxes; the Artiodactyla, or even-toed animals, such as the pig, hippopotamus, peccary, camel, chevrotain, cattle, sheep and deer; and the Perissodactyla, or odd-toed animals, such as the tapir, rhinoceros, and horse. Monsters and midgets, the magnificent elephant at the one extreme, with the little rodent-like lynx at the opposite extreme.



—the bones of the feet of an extinct three-toed horse.

The earliest history of the ungulata shows them to have branched off from a stock which included those early flesh-eaters, the creodonts, with which the early marsupials were not distantly associated. Wonderful discoveries in the Fayum province of Egypt have enabled Dr. Charles William Andrews and other palæontologists to demonstrate that the elephant derives from a generalised type of ungulate called the Moeritherium.

Progenitors of the Whales

The creodonts were, it is startling to realise, the progenitors of the whales; the sirenia arose from a related group, if not indeed from the same stock with the elephants; while the hyrax, now small and degenerate, and found only in Africa and Syria, comes down to us from a line to which the ancestors of whales and sirenia were both related.

* The illustrations on this page and on page 77 are reproduced from "The Horse and Its Relatives," by kind permission of Messrs. G. Allen and Unwin, Ltd.

The ascent of the ungulates from the primitive carnivora could only result from improved methods of locomotion. Five-toed plantigrade action could never have yielded speed and safety to large animals. Hoofs in place of claws gave the necessary support for the body, and a greater length of limb made speed possible.

The change was accomplished, as we see from the records of fossil specimens, by the reduction of the number of toes and the lengthening and strengthening of the remainder. We discover an early stage of the modification in the extinct coryphodons, each of whose four feet were five-toed. The hind feet were plantigrade, flatfooted in action, but the fore feet, before the extinction of the group, had become partly digitigrade. The third or middle toe, corresponding to the second finger of the human hand, had become long and stout, while the first and last toes had undergone reduction.

The Hoof Evolved

A later epoch reveals ungulates which have already lost the first toe, while the third is still larger and more massive, and the animal is found to have walked entirely upon its toes. Still later we come to the three-toed hind foot of the tinothere, which retains, however, four toes in front. The feet of the tapir to-day are modelled upon the same plan, four toes to the front feet, three to the hind. In advance of these animals is the rhinoceros, in which the toes have been reduced to three for each foot.

The horse shed its toes in the same fashion. From an equipment of five, which bore the little fox-sized animals of former eras over soft and yielding ground, it reduced the total on each foot to three, with the middle toe as greatly the longest and stoutest. That middle toe is to-day the hoof of horse, ass and zebra and the two lesser toes are revealed only as vestiges, splints which lie alongside the cannon-bone. Ulna and radius have become fused in the forelimb, and the tibia and fibula are, in the same way, united in the hind limb. This modification of the foot was not achieved, however, by one process alone. Another development led to the equal strengthening of the third and fourth toes, and the corresponding degradation of the first and fifth. From the feet of the giraffe and camel the three superfluous toes have vanished; in the pig the second and fifth persist in diminished form.

The false hoofs of swine, deer and cattle are simply the modified form of toes which were formerly functional. These false hoofs are of undoubted service in the case of the reindeer, serving as support as it crosses the snow, and the pig, which still rejoices to wallow in the mire, obviously derives assistance in the same way. The rhinoceros and the tapir whose habitat is marshy in character, are better served by a multiple system of toed hoofs than by the single hoof of the horse. But, having unconsciously selected such habitat these animals are necessarily restricted to it.

The ungulates began their career as carnivora, they continued as omnivorous, with teeth fitted for either flesh food or vegetation. With the progress of time they relinquished flesh food in favour of herbage, and this diet necessitated a corresponding alteration in the character of the teeth. From chopping meat they had to grind grain, fibre and grass. They had the resources of every green land at their disposal, and they waxed great and many. Mobility, speed, endurance were the main requisites for the great adventure; for this departure from dependence upon teeth and claws as weapons of offence and defence left them largely helpless against their powerful carnivorous enemies. To the elephant his tusks, though whether primarily as weapons or implements for digging, it would be hard to say. To the cattle, sheep, goats, antelopes, horns with a bony core, permanent; to the deer antlers of bone, grown and discarded each year. To the swine canine teeth produced into lacerating tusks. To the rhinoceros horns evolved from modified hair.

Eland and Moose

There seems something like caprice in this equipping of the ungulata. Why should the eland, monarch of the antelopes, retain his horns throughout life, while the elk, or moose, giant of the deer tribe, casts and renews his antlers every year? Why should the female caribou alone among deer, have antlers? The whole story of the antlers of deer is a mystery. Here we have animals throwing an enormous amount of vitality into the production year by year of masses of bone—70 pounds or more in weight it may be—only at the end of the mating season to discard the whole, then forthwith renew the exhausting process. A parallel, perhaps, to the moulting of a bird, or the casting of a hairy coat, but what a prodigal waste of material it seems. If only the elephant could cast its tusks year by year, after the fashion of the deer's antlers, it would be in no danger of extermination, for men would farm it for the sake of its ivory.

THE EUROPEAN BISON

is to be found on the Russian Baltic littoral and is the only survivor of its species on the Continent. During the Great War its forest home was occupied by the Germans, and the animal was at the mercy of a ruthless enemy. A shell is here seen bursting in the midst of a herd.

Indian and African elephants, together with the primitive rhinoceros and hippopotamus, are the giants of terrestrial creation, yet they are small in comparison with their forerunners. Giantism was rampant in the early history of the elephant family. An extinct Indian species known as the Narbadda elephant attained a height of 16 feet; the dinotherius was 18 feet in length; remains of mammoths have been found showing that animals of this species ran to 13 feet. Siberia is a charnel-house of mammoth bones and ivory. The animal became extinct in what, geologically speaking, was merely a yesterday. Entire carcasses have been revealed embedded in the soil of Siberia and Russia; an exceptional thaw melting the frozen morasses in which the animals were interred scores of thousands of years ago.

Elephants and Bisons

A century ago one was discovered near the mouth of the river Lena, with the woolly coat unimpaired upon the undamaged hide, with the eyes preserved and open, with every organ complete, with the last meal of shoots of pine and fir cones undigested.

The obliteration of the older elephant forms is a constant source of speculation to the zoologist. In the case of the mammoth we may with some degree of certainty assign the tragedy to the disappearance of the great forests in Siberia, and to competition with man elsewhere. But with other forms overspecialisation was probably the reason. Giantism, whether of the entire body, or of some particular organ, is always fatal in the long run to a species or genus.

The elephant has been saved from extinction by his phenomenal trunk, which serves as a unique organ of prehension to gather the immense stores of food requisite for his sustenance; while the unparalleled development of the legs, perpendicular pillars of incomparable strength, serve to carry an otherwise unsupportable frame. As we all know, the elephant, when it departs from the standing position, bends the fore legs outward and forward, the hind legs outward and to the rear. The hind limbs are not angulated as in the case of the horse.

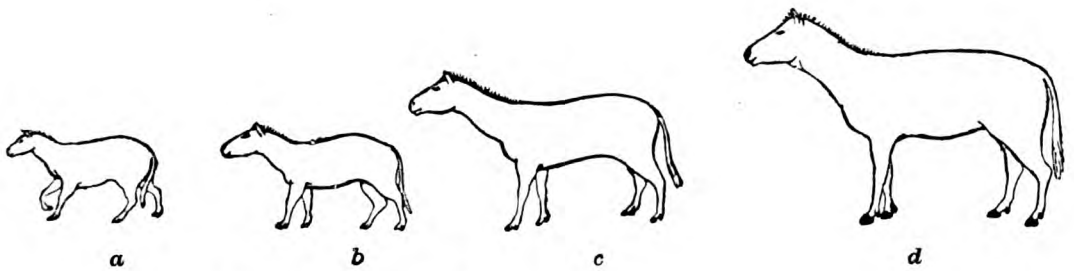
Vegetarianism is decidedly favourable to the production of flesh and muscle and bone in animals, and in no other order, except in the rodents, do we find such numbers as among the ungulates. Nowhere outside the exceptional order named has nature mothered such hosts. The North American bison and certain of the antelopes were the very types of abounding fertility. The disappearance of the mighty herds of bison from the American prairies and of the countless myriads of springboks from the torrid plains of Africa, constitute an indelible stain upon the character of civilisation. Bison, until the great transcontinental railways of America and Canada were built, were numbered literally by millions. They were slaughtered with such merciless contempt for the rights of animals to life that to-day not a single wild herd exists at large. As by a miracle a few isolated individuals were saved, at the last minute of the eleventh hour. A few calves from a great herd were caught by Indians and presented to missionaries, who kept them as pets and brought them to maturity. To-day Canada has in her great national reservation many thousands of bison, descended from those few rescued by Indian hunters.

The European Bison survives on the Russian Baltic littoral, and may be said to be the only survivor of the Typical Bison (*Bos bonasus*) left in Europe. During the Great War its forest home was occupied by the Germans, and the animal was entirely at the mercy of a ruthless enemy.

Types of Ruminants

The bison is, of course, a typical ruminant, an animal which, like all cattle, sheep, goats, giraffes, antelopes, deer and camels, chews the cud. We find the same peculiarity also in the chevrotains, a small, primitive deer-like genus with pig-like characteristics. But in the chevrotain and the camel the stomach is only three-chambered; in the true ruminant the divisions number four. The advantage of the ruminant stomach is obvious. The animal rapidly bites off and swallows a large accumulation of food, passes it down its throat into the paunch or rumen, then lies down to ruminate. The food is now forced back in a succession of compressed ovals, masticated at leisure, and returned to the stomach to undergo assimilation in successive stages in the remaining sections of that organ. The chevrotains, which mark the border line between ruminants and non-ruminants, indicate the manner in which the strange change from simple to complex stomach was effected. Why the fleet deer and the far-seeing, rapid-galloping giraffe should need this power to feed in one place and digest in another, while the horse should be denied it is a puzzle. We might expect to find the hippopotamus, whose great stomach carries three or four bushels of food at a time, to have been ceded the advantage of a ruminant method, but his safety has

been attained by other means; he can automatically seal nostrils and ears and remain at the bottom of a river for five and ten minutes at a time, and then on rising only expose his high-placed nostrils above the surface of the stream and so avoid detection.



THE HORSE AND ITS ANCESTORS.

A comparison in relative size and form. (*a*) *Hyracotherium*, of the Lower Eocene period; (*b*) *Plagiolophus*, of the Middle Eocene; (*c*) *Mesohippus*, of the Oligocene; (*d*) *Merychippus*, of the Miocene; (*e*) *Phiohippus*, of the Pliocene; (*f*) the horse of to-day, *Equus Caballus*.

The horse, however, has no protection save speed, and he is so fashioned that it is impossible for him even to reject poison from his stomach.

The camel not only possesses the ruminant stomach, in a primitive form, but it has the unique faculty of storing water in highly specialised cells in its stomach. It is by virtue of these, not from power to abstain from water, that it is able to make its way in a desert to which no moisture comes save where oases lie. The giraffe, as a matter of fact, goes longer without water than the camel. The latter can abstain for days, but the giraffe is without water for months at a time. But it carries no water cells. As if to balance this we have in the okapi, a fascinating animal of the giraffe type, whose life-history has been worked out only in the twentieth century, a creature which flourishes in dense gloomy forest where water-grown plants form its sole food.

Many essays towards the perfect animal are found among the ungulates. Thus features characteristic of both sheep and cattle combine to give us the musk-ox; the yak, indispensable to the people of Tibet, is clearly a connecting link between the bison and the true oxen. The gnu is an antelope, with the legs of an antelope but the mane and tail proper to a member of the horse tribe, and the horns of an ox.

With the perfecting of the ungulata man's rise above the beasts was assured. In this great order he found his aids to mastery of the wilds. He tamed the horse and made it his prime mover. He domesticated cattle and sheep, nurtured himself and his family upon their milk and flesh, and made raiment from their hide and wool. To-day with all the advance that science has achieved the ungulates are indispensable to us: the horse, oxen and elephant for carriage and haulage, the camel for the desert, the yak for the Asian heights. There is no substitute for milk as the life-food of our babes, there is no substitute for leather, and until all men become vegetarians flocks and herds will have to be maintained to furnish the dinner table of rich and poor alike. Economically the hoofed mammals are, without doubt, of all animals the most important to man in the whole scale of nature. E. A. B.

ASTRONOMY—X

So much modern astronomical work is done by means of photography, and one hears so much of the great saving in strain to the observer and in general facility of work which has arisen from this application, that there is some danger of thinking that a modern astronomer has not to do very much more than to put a plate on his telescope, and that the plate does the rest. This idea is of course grotesquely untrue. The application of photography has in reality put more strain upon the astronomer: in the first place, because it has made possible for him prolonged vigils which would have been useless in the past; and also because it has required him to understand and manipulate more complicated apparatus and methods.

Celestial Photography

It was not very long after the invention of photography that astronomers began to think of utilising the new process. A telescope is in its essence very much the same thing as the camera of the photographer. In each case the lens forms a real image of the object which is sending light to it—an image which can be seen to be real by becoming visible upon a screen of ground glass fixed in the focal plane. The visual telescope's eye-piece is nothing more than a magnifying glass to examine this real image, though of course there is no necessity to spoil the fineness of the image by throwing it on a screen before looking at it. Halley's Comet, for example, which appears every 70 years or so, can, in certain conditions, easily be seen by the naked eye.

The camera has a sensitive photographic plate in the place of the screen, and the multitude of points of light of different intensities which make up the image produce their varying effects upon the sensitive silver salts in the film, and eventually make the picture. Thus there is no essential difference between a telescope and a camera, though the proportions in which they are ordinarily made are so different that at first sight their dissimilarity is more apparent than their likeness.

But in the early days of photography, when the wet collodion process was the only one known, there were very grave difficulties in utilising it in astronomy. Those who are old enough to have been workers with this process will remember that it was exceedingly dirty. One had to place in the camera a plate dripping with solution of nitrate of silver, which made everything in a terrible mess. And the plate remained sensitive only so long as it was wet, so that long exposures were out of the question.

A certain measure of success was obtained in spite of these difficulties, but it was only on the introduction of the dry plate, about the year 1880, that celestial photography became a convenient process. But since that date the sensitiveness of plates has made great strides.

A bright star, it is true, may be photographed in a few seconds, but the result is not of any particular importance. What the astronomer wants to get is a record of the faint objects on the limits of visibility of the telescope, or even beyond them—objects which exist in such numbers that to record them one by one in drawing or at the telescope becomes almost an impossibility.

The greater part of astronomical photography, then, and particularly the more strikingly successful part, depends on using the plate to record extremely faint objects. In this the photographic plate has a power of successful perseverance that the human eye does not possess. If light is so faint that the eye does not appreciate it in half a second, it will not see it at all, however long one may look. But the photographic plate is quite different. We may think of a particle of sensitive bromide of silver as being loosely put together, so that in time, if it is shaken long enough, it may be shaken apart. The faint ray of light is a disturbance in the ether which can communicate itself to the unstable particle, and give it a shake.

Annulling the Earth's Motion

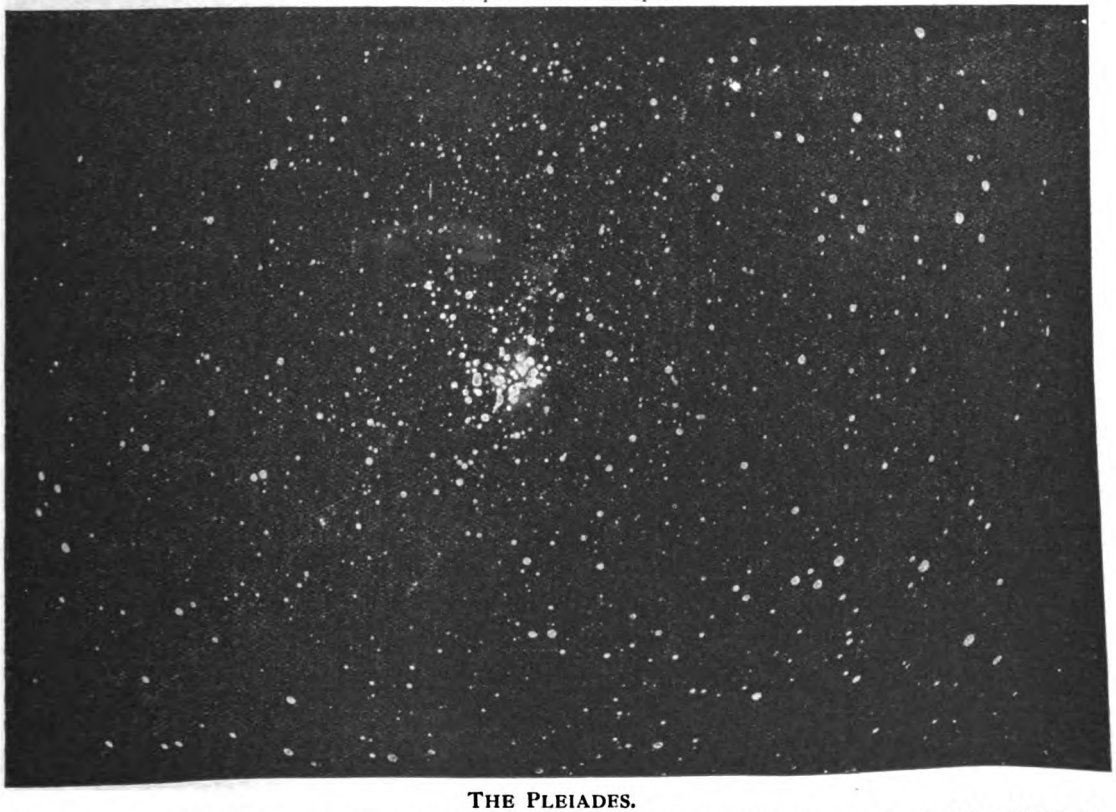
The shake may be extremely slight, so that at first it produces no effect, but if the shaking goes on long enough it will at last succeed in upsetting the balance of the silver bromide and making it what the photographer calls developable. The astronomer, then, has generally to provide for long exposures running into hours, or exceptionally, even to days.

Now it is a well-known axiom of photography that the sitter must sit still. It is equally important that the camera should stand still; but this is just the difficulty when the camera is standing upon the earth, which is all the time turning round underneath the stars. It is an interesting experiment to focus an ordinary landscape camera on far-distant objects, and to set it up in the garden after dark pointing to the stars, leaving the lens uncapped and the slide drawn for an hour or so.

On developing the plate it will be found that the stars have made long, curved trails

THE GREAT COMET OF 1882.

Photographed at the Royal Observatory, Cape of Good Hope, with a landscape camera attached to an Equatorial telescope.



THE PLEIADES.

Photographed 25th October, 1897, at the Cambridge Observatory with a landscape camera attached to an Equatorial telescope.

And if one is able to point the camera up to the pole of the sky and to leave it exposed on the pole for a number of hours, one obtains a beautiful representation of the motion of the stars in the sky around the celestial pole. All this is interesting and instructive, but it does not make good star pictures. To be successful, a star camera or photographic telescope must be mounted in such a way that the motion of rotation of the earth is exactly annulled, and the small images of the stars remain during the whole exposure fixed and immovable upon the plate.

A Map of the Sky

One of the early successes of the new dry plate photography came about when a photographer at the Cape of Good Hope set up his camera on its tripod and tried to make a picture of the brilliant southern comet which appeared in 1882. He found, perhaps to his surprise, that the comet and the stars trailed upon his plate, and he took the unsuccessful result up to the Cape Observatory and showed it to Sir David Gill, who proposed that the camera should on the next night be strapped to a telescope, mounted in the usual way, so that it could be driven by clockwork following precisely the apparent diurnal motion of the stars.

The result was immediately successful, and from it sprang a whole series of enterprises which have profoundly modified the work of the observatory. Sir David Gill at the Cape immediately began to think of making a star map of the southern sky. Meanwhile, two astronomers at the Paris Observatory were devoting their attention to so modifying the ordinary astronomical telescope that it would be capable itself of taking star photographs. The principal difference is that the curve of the lens has to be modified, because while the best visual image is secured by bringing the yellow and green rays to a focus, the best photographic image is secured in the blue and the violet.

These two men, the brothers Henry, were both opticians and astronomers, and they succeeded in getting such good results that in the year 1887 the Director of the Paris Observatory issued invitations to the leading observatories of the world to send representatives to Paris, to discuss a scheme for making a star map of the whole sky.

This enterprise was remarkable in that it was in many respects premature. When the directors of eighteen observatories bound themselves to take part in the enterprise, and laid down binding conditions under which the work was to be done, there was only one of them who commanded, at the moment, an instrument of the necessary kind. The International Map of the Sky was like the *Great Eastern*, rather too sudden a jump forward in advance of experience, and it is not surprising that everything has not gone smoothly with it. In particular, there was a danger that it would stifle experiment and the working out of novel methods, because it bound all the participants to as great a uniformity of procedure as could be obtained.

Happily, however, the difficulty has been in great part avoided by the fact that the astronomers who made the resolutions were usually the first to break them. The work has not progressed so fast as was intended, partly because the estimates of progress were too sanguine, but more because the scope of the work has been continually expanded. What started as a project for making a map of the sky has developed into a double map and a catalogue, and the catalogue has been by far the largest part of the business

Photographic Telescopes

The larger the telescope, the more necessary is it that its lens shall be specially corrected for photography, but the provision of large photographic telescopes is a serious tax on the resources of any observatory, and far outside the possibilities of most amateurs. It will be both instructive in the art of celestial photography, and perhaps also useful to some amateur astronomers, if we consider how a small lens may be mounted in a star camera and attached to an ordinary telescope.

In the first place, the lens must be as large as possible in comparison with its focal length, and should work at what the photographer calls technically *f* by 5, or even *f* by 4. Such lenses are expensive, but it is sometimes possible to pick up for a reasonable sum old lenses which were made for portraiture in the days of the wet plate, and which were made very large compared with modern lenses, because the exposure required with the wet plate was inconveniently long for the sitter. Such a lens was the Willard lens with which Prof. Barnard at the Lick Observatory made his first famous series of pictures of the Milky Way.

Secondly, the lens must be mounted much more rigidly than in the ordinary bellows camera. The purpose of the bellows in the landscape camera is, of course, to provide for a long range of focus so that objects quite near to the camera can be photographed. The star camera will work at a fixed focus adapted to bodies infinitely far away, and

all the range of focus necessary is that small amount required to put the finishing touches, after the tube or box has been made as nearly as possible of the right length.

A wooden box is generally unsatisfactory, because it changes its shape with the amount of moisture in the air, and is liable to spring during an exposure. It is far better to get the local tinsmith to make a tube of fairly heavy tin-plate, strengthened at each end with a flange of small angle iron. The tube need not be more than about double the diameter of the lens, for although on terrestrial objects a lens may give fair definition over quite a large plate, yet when it comes to the far more exacting requirements of the stars it will be found that a field of 5° radius is as much as most lenses will cover satisfactorily. That is to say, if one had a lens of 3 inches aperture working at *f* by 5, or with a focal length of 15 inches, it would not cover a plate much larger than itself.

Fixing the Star Camera

The lens will be screwed in to a plate attached to one end of the tube, and it is important to get it squared on properly so that the axis of the lens coincides with the axis of the tube.

The plate-holder is carried at the other end of the tube. It must be so made that the sensitive plate within is held firmly in position by springs against the stops, so that it cannot move about during the long exposure. The slightest shift of the plate in its slide would be fatal, and some small provision must be made for focusing, which is best done in the way explained by the figure on page 82.

It will be noticed that the whole purpose of this arrangement is not to provide an easy way of focusing afresh for every new picture, but a means of getting an accurate focus once for all and retaining it. We shall see how to do this in due course.

Provision must now be made for strapping the star camera to the tube of the telescope. Some kind of cradle is necessary to keep the tubes apart, and yet in rigid connection, and the straps are best made of strip brass tightened up with pulling screws. With such a camera it is possible to obtain interesting star photographs, even if the telescope is not driven by clockwork; but the process is extremely laborious because it is necessary to keep turning the slow motion handles the whole while, to maintain upon wires in the focus of the telescope a star chosen as the guiding star. But it is essential that the telescope shall be mounted equatorially; that is to say, moving about an axis parallel to the axis of the earth. Otherwise, we shall find on developing the plate that though the central guiding star may have remained fixed, the other stars will be describing circles about it.

EDMUND HALLEY,
who, in 1705, first predicted the reappearance of the periodic Comet named after him.

If the telescope is provided with clockwork, the task of following is much simplified, for the clock will do the greater part of the work and the task of the astronomer is reduced to seeing that the work of the clock is accurate, and to making small adjustments from time to time when the star shows a tendency to drift from the guiding wires.

A word as to the plates required. They will generally be the fastest plates procurable, because there is no light to spare, and it is generally out of the question to multiply the time of exposure by three or four in order to use a slower plate than the fastest obtainable.

Only in one respect can the ordinary plates

be improved upon. Commercial glass is far from flat. If one takes an ordinary negative and looks along its back very obliquely, one sees it is all curves and billows, and a still straight edge reveals hollows of several tenths of a millimetre, besides very often a general curvature of the plate amounting to even more. When it is a question of getting a very accurate focus, and especially when it is a question of making accurate measurements upon the plate, these defects become of importance, and for precise work it is usual on this side of the Atlantic to have astronomical plates coated specially on patent plate-glass.

The small star camera here described necessarily gives pictures on a small scale, and it is a mistake to suppose that this disadvantage can be remedied to any considerable extent by subsequent enlargement of the picture. The size of the grain of the image sets very strict limits to the possibility of enlargement, for the grain soon begins to show, and an enlargement of two or three times is all that can be done with advantage. All kinds of attempts have been made to diminish the size of grain in the plate, while preserving its rapidity ; but up to the present very little progress has been made.

If one wants a larger picture one must have a larger telescope, with a correspondingly larger lens, and this very soon becomes prohibitively expensive. Therefore, it is natural to inquire whether the comparatively cheap reflecting telescope cannot be adapted to photographic use. It certainly can. The most effective and powerful photographic telescopes now at work are reflectors, but there are peculiar difficulties in mounting the mirror so that it is prevented from moving on its seat during a very long exposure, and yet is not gripped in such a way as to destroy its figure.

Unless there are a great many stars upon the plate an astronomical photograph is apt at first sight to be disappointing. The higher its quality, the smaller the star images—so small that they can hardly be seen on the negative without a magnifying lens, and it is almost impossible to make prints from the negative by direct contact ; an enlargement of two or three times is essential if they are to make a picture.

But making pictures is only one part, perhaps the less important part, of the star camera's work. A great majority of the photographs made at the larger observatories are intended to be measured accurately, and for this purpose the smaller the star image the better the result. With a good telescope, on a night when the air is steady, it is possible to obtain star images whose diameter expressed in angular measure is about one and a half seconds, while under exceptional circumstances with the finest telescope in existence, the diameter has been reduced to one second.

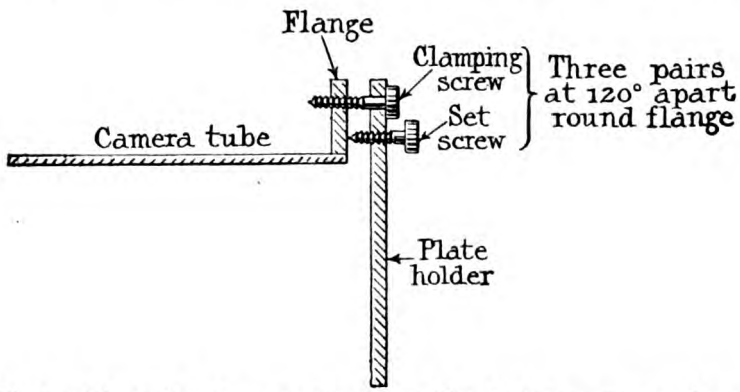


Diagram illustrating the apparatus required for getting an accurate focus in the star camera.

Now, although this from one point of view is a very small image, perhaps a couple of thousandths of an inch big, yet from another point of view it is a coarse representation of things—so coarse indeed, as to be incapable of representing the finer details which are familiar to the observer with the telescope. It does not require an excessively large telescope to show clearly distinct from one another the components of a double star one second apart ; but there is scarcely any photographic telescope, even the largest, which could successfully separate those stars upon the plate. In the moon and on planets there is a great deal of detail too fine to be dealt with by such a relatively coarse process as celestial photography is at the present time.

A. R. H.

ANTHROPOLOGY.—III

So far no Neanderthaloid skulls or teeth have been discovered within the limits of Britain or outside Central and Western Europe.

The Neanderthal type is a most remarkable one, and until at any rate quite recently was regarded by anthropologists as somewhat of a connecting-link between the non-human and the human. It had retained ape-like features in its skeleton. The legs though long were slightly bowed at the knee. The spine was straighter and less incurved over the loins, the thorax was larger in proportion, the arms were longer, the head was bigger than in *Homo sapiens*. The size of the brain was probably much greater than it is in average men and women at the present day (though not so large as the brains of big and very celebrated men in recent times). But the brain appears to have been differently conformed and constituted to ours, and probably did not generate so acute an intellect.

But it was in the *teeth* that Dr. Arthur Keith of the Royal College of Surgeons detected the great specialisation of *Homo neanderthalensis*. Contrary to what one might suppose from the ape-like features in the skeleton (which are undoubtedly retained from a pre-human ancestor), the teeth of Neanderthal Man had departed more markedly from those of the ape type than is the case with *Homo sapiens*.

Neanderthal Man

The incisor teeth and the canines of the Neanderthal man were comparatively small and uniform in appearance, closely pressed together, without any vestige of a diastema or space on either side of the canines. Moreover, the molars, instead of being comparatively short-crowned, with widely separate fangs as they are with us, were very long in the crown and had the bulk or mass of the tooth carried downwards between the fangs, the points of which only projected slightly from the mass of the tooth.

This is a condition which we observe in highly specialised beasts like the oxen, addicted very strictly to a vegetable diet, to the grinding up of twigs and leaves, bark, and shrubby herbage. It is possible, therefore, that the Man of Neanderthal, instead of being the ogre type at first imagined, was not so carnivorous in his taste as his near relation, our own ancestor, but was adapting himself to a mainly vegetable diet.

It is true that he used stone implements of a more or less rude character, but he may have acquired these for purposes of self-defence either against the fierce carnivorous beasts of the period or against the attacks of the nimbler, wittier, more prosperous and numerous "sapient" humans who were beginning to crowd him out of existence. He may have lingered down to so late a period as 30,000 or 40,000 years ago, but our ancestors exterminated him.

It seems scarcely likely that he left any descendants, since it is considered by Dr. Keith that he was so far specialised that even though he might have interbred with the ancestral type of modern Man the progeny would have been a mule, incapable of perpetuating its type. Nevertheless it has been considered by French anthropologists that there are numerous descendants of the Neanderthal type, mixed with *Sapiens*, in Northern and Western Europe, in North Africa, Central Africa, and Western Asia.

The Piltdown Skull

The only point apparently on which this theory is based is the presence in those regions of individuals or tribes with a marked development of the brow-ridge which is so characteristic of the anthropoid ape and of Neanderthal Man. But this is a feature which may have been equally inherited by the primitive types of *Sapiens* (like the modern Australoids) from the original Hominid ancestor of Sapiens and Neanderthalensis, or even may have been re-acquired by new conditions of life.

The creature represented by the Piltdown skull (Eoanthropos) is almost entirely without these brow-ridges, which are similarly absent in the young of anthropoid apes, and which are only slightly developed in the females.

The Piltdown skull, however, probably, from other indications, was that of a woman; and her male may have had brow-ridges as well developed as they are in the Black Australian (see Vol. I., p. 88, for a reproduction of Dr. Smith Woodward's reconstruction of the Piltdown skull).

Early Man probably detested washing and disliked entering the water, but was drawn to do so by his search after fish, and above all shell-fish. Then he took advantage of floating logs to make his way across rivers or narrow straits of water. Next he conceived the idea of tying logs together with lianas or "bush rope" and making rafts which he guided with a long pole. Later still, he hollowed out with fire some big

fallen tree lying on the slope of the river bank or on the seashore, or he pecked out the core with his rude stone axes. Having thus made such primitive dug-out canoes or rafts as may be still seen in use by the aboriginal Australians, his wanderings were not confined to such regions as he could reach dry shod from his original home; but he crossed from one great Malay island to another over a few miles of open sea, and from New Guinea (then nearly reaching to the opposite shores of Queensland) to the Australian continent, where he has been preserved for us very little altered in the type of body and mind characteristic of

Photo: Sir H. H. Johnston.

Irish Types—Scandinavian.

our remote European ancestors of say 200,000 or 300,000 years ago.

Europe, however, still remained the evolutionary area of Man, the region in which more and more superior types of humanity were developed, to go out thence and colonise the rest of the world. Some 200,000 to 300,000 years ago (all these computations of time are still speculative) there arose in Europe a rather divergent form of humanity retaining, however, a good many lowly characteristics: the Negro. A type in which the original crinkly hair of the human ancestor became more and more curled, in which the skin colour became

Photo: Sir H. H. Johnston.

Irish Types—Danish.

darker, almost to blackness, and in which other exaggerations were induced by climate or mode of life.

This type, like the earlier Australoid, disliked recurrences of the ice ages and instinctively made for the warmer regions in its migrations, showing a preference, no doubt, once again for the protection of the forest against the fierce competition of the open plains. So Africa, Southern Asia, and the adjoining islands became peopled mainly by the Negro, one branch of which race even pushed its way across eastern Australia to the southernmost extremity of Tasmania (then a peninsula).

These negroes mingled with the pre-existing Australoids, and out of them grew some such type as that which we call the Melanesian, which becoming bolder with

From a photo lent to Sir H. H. Johnston.

IRISH TYPES—KELTIC AND KELTIBERIAN.

In Ireland at the present day the student of Anthropology can see preserved for him many of the racial types of Ancient Europe—from the Eskimo to the Roman-nosed Italian.

greater intelligence penetrated by means of rude canoes to most of the accessible islands of the Pacific Ocean.

In Europe, or Western Asia, there was another split off, coincident with the development of the Negro. Somewhere or other arose a group of men whose hair instead of becoming curlier, grew lanker and straighter and lost much of the original kink. Their skins remained yellow, but their bodies became almost entirely hairless. These were the Mongols, some of whom retained the original long heads of their ancestors and are now known as the Eskimo, whilst the greater number of them developed a round skull.

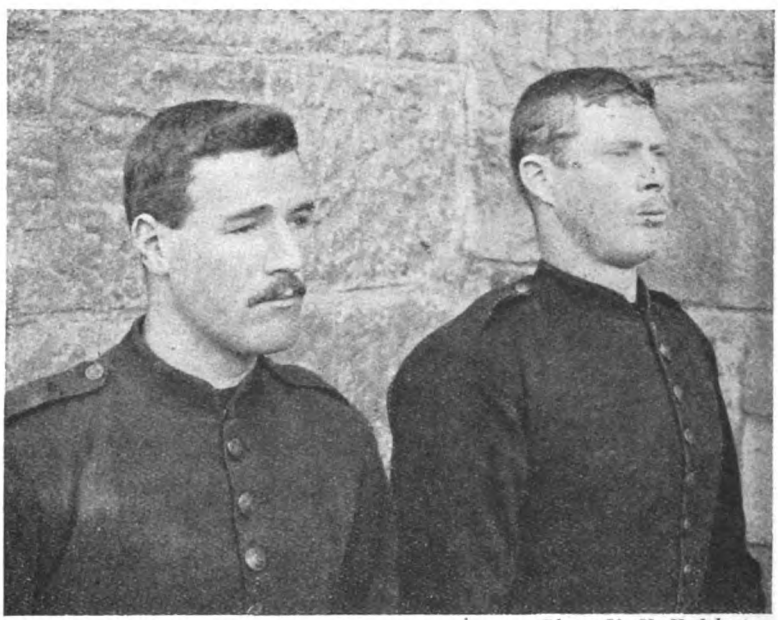


Photo: Sir H. H. Johnston.

IRISH TYPES—Iberian and Caledonian.

In various forms and shapes and often after mingling with the Australoid (who usually preceded them) they made their way right across Asia eastwards to North and South America, and south-eastwards through China to the Malay Archipelago and into the islands of the Pacific; and thence again to South America; and perhaps westwards from Northern Europe, across the crumbling isthmuses reunited by ice-floes, to Iceland and Greenland and Arctic America.

In Northern and Central Europe the orginal human stock finally developed into the ancestral types of the white races or the "Caucasian" sub-species of Man (so-named at one time because it was thought its most perfect physical exemplar—though this is doubtful—was to be met with in the Caucasus).*

These white-skinned peoples with their comparatively handsome features, straight, well-shaped noses, moderate cheekbones, usually white or cream-coloured skins, developed one last variety—that with the pale brown or flaxen hair and blue or grey eyes. This, indeed, seems to have been the Super-man, as it is the dominant human type in many respects at the present day. Some such type as this developed the remarkable Aryan languages which have since become the vehicle of all scientific thought, of the best poetry, of the most accurate science and history. The problem, however, of the Caucasian races is not completely solved in theory.

There have been two main types of "White" man in the history of the last 10,000 years:—There is the Mediterranean form of which the Dynastic or Ancient Egyptian was a good example; as well as the Minôans of Crete and of ancient Greece, the Iberians of North Africa, of Spain, of Southern France and Italy, of Western France, Ireland, England and Scotland; the dark-haired people in Denmark, the dark-haired, brown-eyed Lithuanians, Albanians, Russians, Persians, Circassians, and perhaps the far-away Ainu of North-east Asia. And there is the fair-haired "Aryan" type, the long-headed and the short-headed tall, blond, grey-eyed or blue-eyed races of Northern and Central Europe.

These fair-haired super-men, perhaps aided by the discovery of the use of iron, seem (by permissible guess-work) to have occupied a good deal of Russia at one time and to have started a wonderful Neolithic civilisation in West Central Asia, in the arid regions of Turkestan which once were well-watered and easily cultivated.

* It might be simpler to call the true European race the White man; only that a good many of its examples in the Mediterranean basin, North-east Africa, and Western Asia are not white in skin-colour any longer.

Here, some 10,000 to 20,000 years ago, they apparently started the cultivation of trees and plants and the domestication of wild animals. To them probably we owe the taming of some form of wild ox, of the horse, the sheep, the goat, and the development of the already domesticated dog into many different breeds; to them also we owe grain and many fruits.

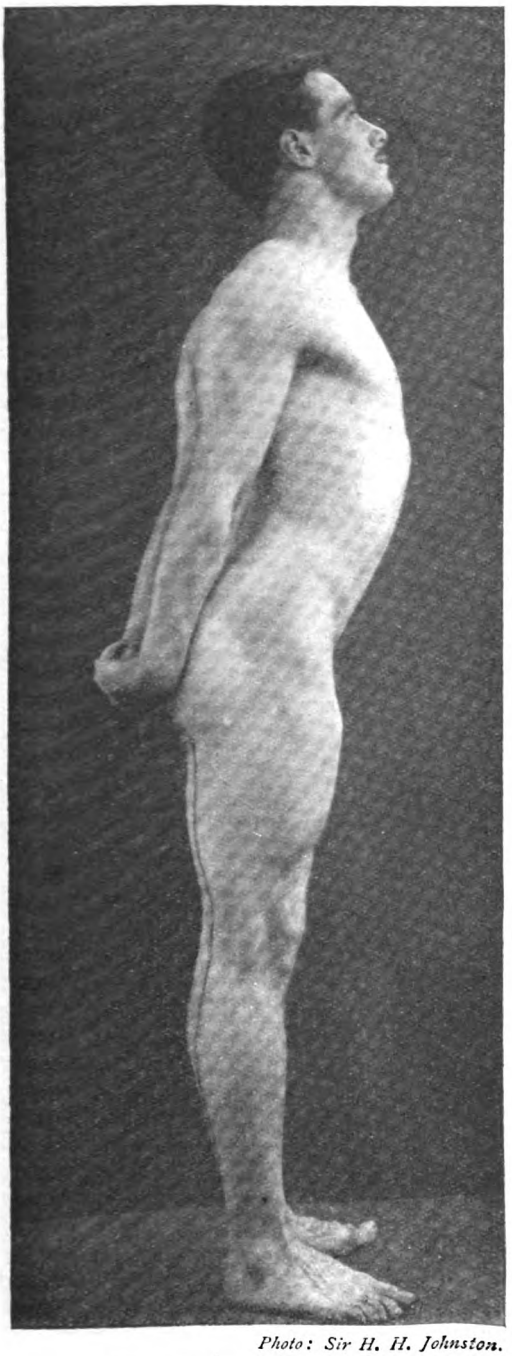


Photo: Sir H. H. Johnston.

THE AVERAGE WHITE MAN

belonging to the species which developed in Northern and Central Europe and remains the dominant type.

Possibly this proto-Aryan people of Turkestan were the first men of any degree of civilisation to invade savage India and savage South-west Asia. They may have inspired the earliest civilisations of Mesopotamia.

This Neolithic civilisation passed from Mesopotamia into Arabia and Syria and thus entered Egypt. It may be also that these same wonderful white men of Northern and Eastern Europe had found their way through Germany and France to the Balkan Peninsula, Italy, Spain and North Africa. But whether or not connected with them originally, there began to arise 10,000 years ago (or so) a remarkable civilisation in the Mediterranean—that of Crete, of Egypt, of Syria, Sardinia, Southern Spain, and North Africa.

The two civilisations—that of the Mediterranean and that of East Central Europe and Western Asia—and the two great racial types, the fair-haired and the dark-haired White man, met and clashed and intermingled, acted and reacted on one another till from their almost complete fusion has resulted the Europe, the West Asia and the North Africa of to-day. There are fair-haired, grey-eyed people in the Atlas Mountains of North Africa and in the mountains of Afghanistan and Armenia; there are dark-haired races in Northern and Western Europe; the original Greeks and Romans, the Goths and Kelts and Germans were fair-haired people.

Irish Types

In Ireland at the present day the student of anthropology can see preserved for him—more or less clearly marked as in a museum—many of the racial types of ancient Europe—the Eskimo and Red Indian type, the Australoid and Negroid, the handsome Iberian from the Mediterranean, the stalwart, red-haired Caledonian (early type of White man from Northern or North-eastern Europe), the fair-haired, grey-eyed Kelt, the brown-haired, blue-eyed Saxon, the tall and handsome Scandinavian (with his lint-white hair and his violet eyes), the under-sized Welshman, the huge, raw-boned Lowland Scot, the all-round average snub-nosed Englishman, the handsome Huguenot of France, and the Roman-nosed Italian.

The outcome of all this development at the present day is that the world is populated by a number of distinct races of Man. H. H. J.

Continued from page 37.

LANGUAGES:

***Contributors*:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A.[Lond.]), SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).**

LATIN.—X

FIRST OR A-CONJUGATION—PASSIVE VOICE.

EXAMPLE.—**ămŏr, ămātŭs sum, ămārī,** *to be loved.*

Indicative Mood

PRESENT	IMPERFECT
Sing.	*Sing.*
ăm-**ŏr**, *I am loved.*	ăm-**ābăr**, *I was being loved.*
ăm-**ārĭs**, *thou art loved.*	ăm-**ābārĭs** or ăm-**ābārĕ**, *thou wast being loved.*
ăm-**ātŭr**, *he is loved.*	ăm-**ābātŭr**, *he was being loved.*
Plur.	*Plur.*
ăm-**āmŭr**, *we are loved.*	ăm-**ābāmŭr**, *we were being loved.*
ăm-**āmĭnī**, *ye are loved.*	ăm-**ābāmĭnī**, *ye were being loved.*
ăm-**antŭr**, *they are loved.*	ăm-**ābantŭr**, *they were being loved.*

FUTURE	PERFECT
Sing.	*Sing.*
ăm-**ābŏr**, *I shall be loved.*	ămāt-**ŭs** sum, *I have been loved.*
ăm-**ābĕrĭs** or ăm-**ābĕrĕ**, *thou wilt be loved.*	ămāt-**ŭs** ĕs, *thou hast been loved.*
ăm-**ābĭtŭr**, *he will be loved.*	ămāt-**ŭs** est, *he has been loved.*
Plur.	*Plur.*
ăm-**ābĭmŭr**, *we shall be loved.*	ămāt-ī sŭmŭs, *we have been loved.*
ăm-**ābĭmĭnī**, *ye will be loved.*	ămāt-ī estis, *ye have been loved.*
ăm-**ābuntŭr**, *they will be loved.*	ămāt-ī sunt, *they have been loved.*

PLUPERFECT	FUTURE PERFECT
Sing.	*Sing.*
ămāt-**ŭs** ĕram, *I had been loved.*	ămāt-**ŭs** ĕrō, *I shall have been* or *was loved.*
ămāt-**ŭs** ĕrās, *thou hadst been loved.*	ămāt-**ŭs** ĕrĭs, *thou wilt have been* or *wast loved.*
ămāt-**ŭs** ĕrāt, *he had been loved.*	ămāt-**ŭs** ĕrĭt, *he will have been* or *was loved.*
Plur.	*Plur.*
ămāt-ī ĕrāmŭs, *we had been loved.*	ămāt-ī ĕrĭmŭs, *we shall have been* or *were loved.*
ămāt-ī ĕrātĭs, *ye had been loved.*	ămāt-ī ĕrĭtĭs, *ye will have been* or *were loved.*
ămāt-ī ĕrant, *they had been loved.*	ămāt-ī ĕrunt, *they will have been* or *were loved.*

Subjunctive Mood

PRESENT	IMPERFECT
Sing.	*Sing.*
ăm-**ĕr**, *I may be loved.*	ăm-**ārĕr**, *I might be loved.*
ăm-**ērĭs** or ăm-**ērĕ**, *thou mayst be loved.*	ăm-**ārērĭs** or ăm-**ārērĕ**, *thou mightst be loved.*
ăm-**ētŭr**, *he may be loved.*	ăm-**ārētŭr**, *he might be loved.*
Plur.	*Plur.*
ăm-**ēmŭr**, *we may be loved.*	ăm-**ārēmŭr**, *we might be loved.*
ăm-**ēmĭnī**, *ye may be loved.*	ăm-**ārēmĭnī**, *ye might be loved.*
ăm-**entŭr**, *they may be loved.*	ăm-**ārentŭr**, *they might be loved.*

PERFECT	PLUPERFECT
Sing.	*Sing.*
ămāt-**ŭs** sim, *I may have been loved.*	ămāt-**ŭs** essem, *I might have been loved.*
ămāt-**ŭs** sĭs, *thou mayst have been loved.*	ămāt-**ŭs** essēs, *thou mightst have been loved.*
ămāt-**ŭs** sit, *he may have been loved.*	ămāt-**ŭs** essĕt, *he might have been loved.*
Plur.	*Plur.*
ămāt-ī sīmŭs, *we may have been loved.*	ămāt-ī essēmŭs, *we might have been loved.*
ămāt-ī sītĭs, *ye may have been loved.*	ămāt-ī essētĭs, *ye might have been loved.*
ămāt-ī sint, *they may have been loved.*	ămāt-ī essent, *they might have been loved.*

Imperative Mood

PRESENT	FUTURE
Sing.	*Sing.*
ăm-**ārĕ**, *be thou loved.*	am-**ātor**, *thou shalt be loved.*
	am-**ātŏr**, *let him be loved.*
Plur.	*Plur.*
ăm-**āmĭnī**, *be ye loved.*	ăm-**antŏr**, *let them be loved.*

Infinitive Mood

PRESENT	PERFECT
ăm-ārī, *to be loved.*	ămāt-**ŭs** essĕ, *to have been loved.*

FUTURE

ămāt-**um** īrī, *to be about to be loved.*

Participles

PERFECT	GERUNDIVE
ămāt-**ŭs, -ă, -um**, *loved* or *having been loved.*	ăm-**andŭs, -andă, -andum**, *fit to be loved.*

SECOND OR E-CONJUGATION

EXAMPLE. — **Mŏnĕŏr, monĭtŭs sum, mŏnērī,** *to be advised.*

Indicative Mood

PRESENT	IMPERFECT
Sing.	*Sing.*
mŏn-**ĕŏr,** *I am advised.*	mŏn-**ēbăr,** *I was being advised.*
mŏn-**ērĭs,** *thou art advised.*	mŏn-**ēbārĭs** or mŏn-**ēbārĕ,** *thou wast being advised.*
mŏn-**ētŭr,** *he was advised.*	mŏn-**ēbātŭr,** *he was being advised.*
Plur.	*Plur.*
mŏn-**ēmŭr,** *we are advised.*	mŏn-**ēbāmŭr,** *we were being advised.*
mŏn-**ēmĭnī,** *ye are advised.*	mŏn-**ēbāmĭnī,** *ye were being advised.*
mŏn-**entŭr,** *they are advised.*	mŏn-**ēbantŭr,** *they were being advised.*
FUTURE	PERFECT
Sing.	*Sing.*
mŏn-**ēbŏr,** *I shall be advised.*	mŏnĭt-**ŭs** sum, *I have been* or *was advised.*
mŏn-**ēbĕrĭs** or mŏn-ēbĕrĕ, *thou wilt be advised.*	mŏnĭt-**ŭs** ĕs, *thou hast been* or *wast advised.*
mŏn-**ēbĭtŭr,** *he will be advised.*	mŏnĭt-**ŭs** est, *he has been* or *was advised.*
Plur.	*Plur.*
mŏn-**ēbĭmŭr,** *we shall be advised.*	mŏnĭt-**ī** sumus, *we have been* or *were advised.*
mŏn-**ēbĭmĭnī,** *ye will be advised.*	mŏnĭt-**ī** estĭs, *ye have been* or *were advised.*
mŏn-**ēbuntŭr,** *they will be advised.*	mŏnĭt-**ī** sunt, *they have been* or *were advised.*
PLUPERFECT	FUTURE PERFECT
Sing.	*Sing.*
mŏnĭt-**ŭs** ĕram, *I had been advised.*	mŏnĭt-**ŭs** ĕrō, *I shall be advised.*
mŏnĭt-**ŭs** ĕrās, *thou hadst been advised.*	mŏnĭt-**ŭs** ĕris, *thou wilt be advised.*
mŏnĭt-**ŭs** ĕrăt, *he had been advised.*	mŏnĭt-**ŭs** ĕrĭt, *he will be advised.*
Plur.	*Plur.*
mŏnĭt-**ī** ĕrāmŭs, *we had been advised.*	mŏnĭt-**ī** ĕrĭmŭs, *we shall be advised.*
mŏnĭt-**ī** ĕrātĭs, *ye had been advised.*	mŏnĭt-**ī** ĕrĭtĭs, *ye will be advised.*
mŏnĭt-**ī** ĕrant, *they had been advised.*	mŏnĭt-**ī** ĕrunt, *they will be advised.*

Subjunctive Mood

PRESENT	IMPERFECT
Sing.	*Sing.*
mŏn-**ĕăr,** *I may be advised.*	mŏn-**ērĕr,** *I might be advised.*
mŏn-**ĕărĭs** or mŏn-**ĕărĕ,** *thou mayst be advised.*	mŏn-**ērērĭs** or mŏn-**ērērĕ,** *thou mightst be advised.*
mŏn-**ĕātŭr,** *he may be advised.*	mŏn-**ērētŭr,** *he might be advised.*
Plur.	*Plur.*
mŏn-**ĕāmŭr,** *we may be advised.*	mŏn-**ērēmŭr,** *we might be advised.*
mŏn-**ĕāmĭnī,** *ye may be advised.*	mŏn-**ērēmĭnī,** *ye might be advised.*
mŏn-**ĕantŭr,** *they may be advised.*	mŏn-**ērentŭr,** *they might be advised.*
PERFECT	PLUPERFECT
Sing.	*Sing.*
mŏnĭt-**ŭs** sim, *I may have been advised.*	mŏnĭt-**ŭs** essem, *I might have been advised.*
mŏnĭt-**ŭs** sīs, *thou mayst have been advised.*	mŏnĭt-**ŭs** essēs, *thou mightst have been advised.*
mŏnĭt-**ŭs** sĭt, *he may have been advised.*	mŏnĭt-**ŭs** essĕt, *he might have been advised.*
Plur.	*Plur.*
mŏnĭt-**ī** sīmŭs, *we may have been advised.*	mŏnĭt-**ī** essēmŭs, *we might have been advised.*
mŏnĭt-**ī** sītĭs, *ye may have been advised.*	mŏnĭt-**ī** essētĭs, *ye might have been advised.*
mŏnĭt-**ī** sint, *they may have been advised.*	mŏnĭt-**ī** essent, *they might have been advised.*

Imperative Mood

PRESENT	FUTURE
Sing.	*Sing.*
mon-**ērĕ,** *be thou advised.*	mŏn-**ētŏr,** *thou shalt be advised.*
	mŏn-**ētŏr,** *let him be advised.*
Plur.	*Plur.*
mon-**ēmĭnī,** *be ye advised.*	mŏn-**entŏr,** *let them be advised.*

Infinitive Mood

PRESENT	PERFECT
mŏn-**ērī,** *to be advised.*	mŏnĭt-**ŭs** essĕ, *to have been advised.*

FUTURE

mŏnĭt-**um** īrī, *to be about to be advised.*

Participles

PERFECT	GERUNDIVE
mŏnĭt-**ŭs, -ă, -ŭm,** *advised* or *having been advised.*	mŏn-**endŭs, -endă, -endum,** *fit to be advised.*

THIRD OR CONSONANT-CONJUGATION

EXAMPLE.—**lĕgŏr, lectŭs sum, lēgī,** *to be read.*

Indicative Mood

PRESENT	IMPERFECT
Sing.	*Sing.*
lĕg-**or,** *I am read.*	lĕg-**ēbăr,** *I was being read.*
lĕg-**ĕrĭs,** *thou art read.*	lĕg-**ēbārĭs** or lĕg-**ēbārĕ,** *thou wast being read.*
lĕg-**ĭtŭr,** *he is read.*	lĕg-**ēbātŭr,** *he was being read.*
Plur.	*Plur.*
lĕg-**ĭmŭr,** *we are read.*	lĕg-**ēbāmŭr,** *we were being read.*
lĕg-**ĭmĭnī,** *ye are read.*	lĕg-**ēbāmĭnī,** *ye were being read.*
lĕg-**untŭr,** *they are read.*	lĕg-**ēbantŭr,** *they were being read.*

FUTURE	PERFECT
Sing.	*Sing.*
lĕg-**ăr,** *I shall be read.*	lect-**ŭs** sum, *I have been or was read.*
lĕg-**ērĭs** or lĕg-**ērĕ,** *thou wilt be read.*	lect-**ŭs** ĕs, *thou hast been or wast read.*
lĕg-**ētŭr,** *he will be read.*	lect-**ŭs** est, *he has been or was read.*
Plur.	*Plur.*
lĕg-**ēmŭr,** *we shall be read.*	lect-**ī** sŭmŭs, *we have been or were read.*
lĕg-**ēmĭnī,** *ye will be read.*	lect-**ī** ĕstĭs, *ye have been or were read.*
lĕg-**entŭr,** *they will be read.*	lect-**ī** sunt, *they have been or were read.*

PLUPERFECT	FUTURE PERFECT
Sing.	*Sing.*
lect-**ŭs** ĕram, *I had been read.*	lect-**ŭs** ĕrō, *I shall have been read.*
lect-**ŭs** ĕrās, *thou hadst been read.*	lect-**ŭs** ĕrĭs, *thou wilt have been read.*
lect-**ŭs** ĕrăt, *he had been read.*	lect-**ŭs** ĕrĭt, *he will have been read.*
Plur.	*Plur.*
lect-**ī** ĕrāmŭs, *we had been read.*	lect-**ī** ĕrĭmŭs, *we shall have been read.*
lect-**ī** ĕrātĭs, *ye had been read.*	lect-**ī** ĕrĭtĭs, *ye will have been read.*
lect-**ī** ĕrant, *they had been read.*	lect-**ī** ĕrunt, *they will have been read.*

Subjunctive Mood

PRESENT	IMPERFECT
Sing.	*Sing.*
lĕg-**ăr,** *I may be read.*	leg-**ĕrĕr,** *I might be read.*
lĕg-**ārĭs,** *thou mayst be read.*	leg-**ērērĭs** or lĕg-**ĕrērĕ,** *thou mightst be read.*
lĕg-**ātŭr,** *he may be read.*	leg-**ērētŭr,** *he might be read.*
Plur.	*Plur.*
lĕg-**āmŭr,** *we may be read.*	leg-**ĕrēmŭr,** *we might be read.*
lĕg-**āmĭnī,** *ye may be read.*	leg-**ĕrēmĭnī,** *ye might be read.*
lĕg-**antŭr,** *they may be read.*	leg-**ĕrentŭr,** *they might be read.*

PERFECT	PLUPERFECT
Sing.	*Sing.*
lect-**ŭs** sim, *I may have been read.*	lect-**ŭs** essem, I *might have been read.*
lect-**ŭs** sīs, *thou mayst have been read.*	lect-**ŭs** essēs, *thou mightst have been read.*
lect-**ŭs** sĭt, *he may have been read.*	lect-**ŭs** essĕt, *he might have been read.*
Plur.	*Plur.*
lect-**ī** sīmŭs, *we may have been read.*	lect-**ī** essēmŭs, *we might have been read.*
lect-**ī** sītĭs, *ye may have been read.*	lect-**ī** essētĭs, *ye might have been read.*
lect-**ī** sint, *they may have been read.*	lect-**ī** essent, *they might have been read.*

Imperative Mood

PRESENT	FUTURE
Sing.	*Sing.*
lĕg-**ĕrĕ,** *be thou read.*	lĕg-**ĭtŏr,** *thou shalt be read.*
	lĕg-**ĭtŏr,** *let him be read.*
Plur.	*Plur.*
lĕg-**ĭmĭnī,** *be ye read.*	lĕg-**untŏr,** *let them be read.*

Infinitive Mood

PRESENT	PERFECT
lĕg-**ī,** *to be read.*	lect-**ŭs** essĕ, *to have been read.*

FUTURE

lect-**um** īrī, *to be about to be read.*

Exercise 10

Translate into English:—

1. Deiotarus legatos ad me misit, se cum omnibus copiis esse venturum. 2. Deliberatur de Avarico in communi concilio, incendi placeret an defendi. 3. Consul me primum sententiam rogavit. 4. Quid agis? Caesaris librum de Bello Gallico lego. 5. Qui ipse se contemnit, in eo est desiderium virtutis. 6. Dicendum est saepius. 7. Nos dicamur duo omnium beatissimi esse. 8. Tantus timor omnem exercitum occupavit. 9. Relinquebatur una per terram hostium via.

Translate into Latin:—

1. While these things were happening at Rome, Caesar sent ambassadors into Britain. 2. The general gave the booty to the soldiers who had captured the city. 3. Not long afterwards (not much afterwards) the Romans established camps in their land. 4. They see and feel the same as you. 5. You seem to me a prudent man. 6. To every one his place was marked out. 7. One part of Italy is fortified by mountains and the other by the sea. 8. You wage war bravely rather than prosperously. 9. Caesar at once sent back the ambassadors.

E. A. B.

FRENCH.—X.

In learning any foreign language the student naturally meets with most difficulty in mastering the use of the verbs. This is particularly the case in inflected languages like Latin, Greek, and French, which differ widely from English, in which only a few relics survive of the ancient inflexions, and which for the most part employs other expedients for expressing the differences of meaning implied in mood, tense, etc. We have already used a few verbs freely in illustrative sentences, since it is impossible to compose a sentence without this essential member. Now the student must brace himself for a sustained effort, in which the amount of familiarity he has so far acquired will prove useful.

Inflexions.—French verbs undergo inflexions of number, person, mood, and tense. By means of auxiliary verbs, also, other tenses are formed, which being expressed by more than one word are described as compound tenses.

Besides the fundamental stem or root of any verb, such as **aim-**, stem of **aimer,** *to love*, or **chant-**, stem of **chanter,** *to sing*, we may find it helpful to distinguish four other principal tenses from the stems of which the other tenses are formed. These principal tenses are the present infinitive, the present participle, the past participle, and the past definite or preterit. Let us take these in order, beginning with the present infinitive :—

(1) From the Present Infinitive are formed the future and the conditional tenses : thus from **chanter,** *to sing*, we get **chanterai,** *I shall sing*, **chanterais,** *I should sing ;* from **finir,** *to finish*, **finirai** and **finirais ;** from **recevoir,** *to receive*, **recevrai** and **recevrais ;** from **vendre,** *to sell*, **vendrai** and **vendrais.**

(2) From the Present Participle we get the plural of the present indicative, the imperfect indicative, and the present subjunctive : thus from **chantant,** *singing*, we have **chantons, chantez, chantent,** *we, you, they sing ;* from **finissant,** *finishing*, we have **finissais,** *I was finishing*, **finisse,** *I may finish ;* and from **recevant,** *receiving*, **recevais,** *I was receiving.* In the 3rd conjugation the present indicative differs from the present participle : thus, **reçoive,** *I may receive ;* but **recevions, receviez,** *we* and *you may receive.*

(3) From the Past Participle all the compound tenses are formed : thus, **j'ai chanté,** *I have sung*, **j'eus chanté,** *I had sung*, **j'eusse chanté,** *I might have sung.*

(4) From the Present Infinitive is formed the imperative : thus, **chante,** *sing*, **chantons** *let us sing*, **chantez,** *sing* (ye), **qu'ils chantent,** from **chante,** *he sings*, **chantons,** *we sing*, **chantez,** *you sing*, **chantent,** *they sing ;* **finis,** *finish*, **reçois,** *receive*, **vends,** *sell*, from **finis,** *he finishes*, **reçois,** *he receives*, **vends,** *he sells.*

(5) From the Past Definite or Preterit is formed the present subjunctive : thus, from **chantai,** *he sang*, we have **chantasse,** *I might sing ;* from **finis, finisse ;** from **reçu, reçusse ;** and from **vendis, vendisse.**

The student should not try to learn all this as a series of abstract rules, but should read it through now and recur to it later.

Classes of Verbs.—There are five classes of verbs in French—active, passive, neuter, reflexive, and impersonal verbs.

(1) Active verbs express the action performed by the subject, and take a direct object, as in—

Le loup mange l'agneau.	*The wolf eats the lamb.*

(2) Passive verbs express an action sustained by the subject, as in—

Je suis mordu par mon chien.	*I am bitten by my dog.*

Any active verb may be turned into the passive by changing the form of the statement, thus—

L'agneau est mangé par le loup.	*The lamb is eaten by the wolf.*

(3) Neuter verbs express an action or state of the subject, and do not take a direct object ; in other words, while active verbs are transitive, their action passing to a direct object, neuters are intransitive, as—

Je dors, *I sleep.*	Je vais, *I go.*

(4) Reflexive verbs express an action that is performed by, and at the same time is reflected back upon, the subject, as in—

Je me repose.	*I rest myself, I rest.*
Je m'assieds.	*I set myself down, I sit.*

(5) Impersonal verbs express actions without any definite subject or personal agent, as in—

Il pleut, *it rains.*	Il neige, *it snows.*

Number.—Verbs, like nouns, adjectives, etc., have two numbers, singular and plural, as in **j'ai,** *I have*, **nous avons,** *we have.*

Person.—There are three persons, the first representing the person that speaks, as in **je chante,** *I sing ;* the second, the

person addressed, as in **tu sais,** *thou knowest;* the third, the person spoken of, as in **il chante,** *he sings.* Each of these persons has a particular ending, which is affixed to the stem of the verb, and each, further, has a different ending for the singular and the plural: thus, **nous chantons,** *we sing;* **vous savez,** *you know;* **ils chantent,** *they sing.*

Mood.—The word "mood" is etymologically a variant of the word "mode." Mood is the mode in which the action or state expressed by the verb is presented. There are five moods:—

(1) The Indicative simply indicates that the action takes place, has taken place, or will take place, as in—

Vous chantez, *you sing.* Nous avons mangé, *we have eaten.*
Il mangera, *he will eat.*

(2) The Imperative expresses command, as in—

Mange, *eat.* Taisez-vous, *be silent.*

(3) The Conditional implies that an action would take place if a certain condition were fulfilled, as in—

Je marcherais plus longtemps si j'étais jeune. *I should walk longer if I were young.*

(4) The Subjunctive presents the action in an uncertain or hypothetical manner, as dependent upon another action, thus—

Je veux que tu chantes. *I wish you to sing.*

que tu chantes depends upon the verb in **je veux,** *I wish.*

(5) The Infinitive expresses the action of the verb vaguely and indefinitely, without any relation to a subject, and therefore without any inflexion for number or person, as—

Chanter, *to sing.* Finir, *to finish.*

VOCABULARY

acheter, *to buy.*
âgé, *old, aged.*
avoir besoin, *to want.*
avoir envie, *to desire.*
avoir peur, *to be afraid* (of).
avoir raison, *to be right.*
avoir soin, *to take care.*
la belle-mère, *the mother-in-law.*
le champ, *the field.*
comme, *as, like.*
commencer, *to begin.*
danser, *to dance.*
la demoiselle, *the young lady.*
dirait, (he) *would say.*
donc, *then.*
dormir, *to sleep.*
écrire, *to write.*
fatigué, *tired.*
l'honneur (m.), *honour.*
le journal, *the newspaper.*
lire, *to read.*
marcher, *to walk.*
le moment, *the instant, the time.*
où? *where?*
la page, *the page* (of a book, etc.).
pâle, *pale.*
le postillon, *the postilion.*
le rideau, *the curtain.*
le roman, *the romance, the novel.*
sûr, *sure, certain.*
le sous-lieutenant, *the second lieutenant.*
tomber, *to fall.*
travailler, *to work.*
trop, *too much.*
la vie, *the life.*
vit (he, she, or it), *lives.*

Exercise 17

1. Où sommes-nous donc, postillon? 2. Il était pâle, non pas comme un mort, mais comme la mort elle-même. 3. Je ne sais pas ce qu'elle a pour vous, mais je sais ce qu'elle a pour moi. 4. Vous me faites beaucoup trop d'honneur. 5. On dirait que c'est toujours le même rideau. 6. J'étais, il est vrai, sous-lieutenant à ce moment-là. 7. J'en étais bien sûr. 8. On a pris la forteresse de Liége. 9. C'était une demoiselle. 10. J'avais donc dix-huit ans. 11. J'y ai vu commencer bien des romans. 12. Il était plus âgé que moi. 13. Je vous l'ai dit, tout m'était égal. 14. On vit plus dans la vie qu'on n'a pas que dans la vie qu'on a. 15. Avez-vous besoin de votre domestique? 16. Votre père a-t-il besoin de vous et de vos sœurs? 17. Il n'a pas beaucoup d'argent, mais il en a assez. 18. A-t-il bien besoin de ses livres? 19. Il en a bien besoin. 20. N'avez-vous rien dit à mon cousin?

Exercise 18

1. Has your mother-in-law anything to do? 2. She has nothing to do. 3. Has she two pages to write? 4. No, sir, she has only one. 5. Do you intend to read this newspaper? 6. Yes, madam, I intend to read it. 7. Are you right to buy a velvet coat? 8. I am right to buy one. 9. Does your little girl want to sleep? 10. Yes, sir, she wants to sleep, she is tired. 11. Are you afraid of falling? 12. I am not afraid of falling. 13. Has the gardener time to work in the fields? 14. He has no wish to work in the fields. 15. Are your fields as large as mine? 16. They are larger than yours. 17. Do you wish to walk? 18. I do not wish to walk, but I wish to dance. 19. How old is your son? 20. He is sixteen.

Key to Exercise 15

1. The pencils that I have are better than those which you have. 2. You have both. 3. Have you some ripe pears? 4. We have some, we have also plenty of pineapples and apricots. 5. Of what do you wish to speak? 6. The Englishman of whom you speak here. 7. What are you doing this morning? I know of whom you are speaking. 9. For whom are you making this coat? 10. I have seen her and her sister. 11. I have written to them and their brother. 12. The king sent me to you. 13. This horse belongs to me. 14. I speak only to you. 15. I have seen him only twice. 16. She spoke to me of nothing but her son. 17. We do not know who has arrived. 18. Have you any others? 19. I have still a few. 20. I have seen nothing.

Key to Exercise 16

1. Lesquels votre frère a-t-il? 2. Il en a quelques-uns. 3. Lequel avez-vous? 4. L'épicier a-t-il beaucoup de sucre dans son magasin? 5. Il n'en a guère, mais il a beaucoup de beurre et de fromage. 6. Avez-vous assez de thé? 7. J'en ai assez. 8. Vous êtes plus heureux que moi. 9. Avez-vous plus de courage que lui? 10. Il a plus de courage que moi. 11. À quoi pensez-vous? 12. De quoi parlez-vous à votre frère? 13. Ce qu'il vous dit est-il vrai? 14. Ils n'ont vu que moi. 15. Votre oncle nous a envoyés chez elle. 16. Ils n'avaient écrit qu'à elle. 17. Mon cousin a écrit à toi et à ta sœur. 18. Mon frère m'a envoyé à vous hier. 19. Quelqu'un m'a dit cela. 20. Je n'ai vu ni l'un ni l'autre.

E. A. B.

GERMAN.—VII

Strong Verbs are divided into classes according to the stem vowel in the Pres., Pret., and Past Part. We shall give only the Pres. Infin., the 1st pers. sing. Pret. Ind., and the Past Part., as the student will then be able to conjugate any of them by means of the model ſingen given in the last lesson. In certain verbs there is a slight change of vowel in the 2nd and 3rd pers. sing. Pres. Ind.; these will be noted as they occur.

We may conveniently divide the strong verbs into three main classes with various subdivisions. Class 1, verbs whose Infinitive, Preterite, and Past Participle have each a different vowel. Class 2, verbs whose Infinitive and Past Participle have the same vowel. Class 3, verbs whose Preterite and Past Participle have the same vowel.

Class 1

a. Vowels **a-i-u**, ſingen, ſang, geſungen, *sing.* To this subdivision belong about 16 verbs, all with stems ending in **nd**, **ng**, and **nk**.

b. Vowels **i-a-o**, ſchwimmen, ſchwamm, geſchwommen, *swim.* About 6 verbs, the stem ending in **mm** and **nn**.

c. Vowels **e-a-o**, brechen, brach, gebrochen, *break.* About 22 verbs, the stems ending in various consonants.

d. Vowels **i** or **ie-a-e**, bitten, bat, gebeten, 3 verbs—*beg;* liegen, lag, gelegen, *lie;* ſitzen, ſaß, geſeſſen, *sit.*

Class 2

a. Vowels **e-a-e**, ſehen, ſah, geſehen, *see.* About 10 verbs.

b. Vowels **a-u-a**, fahren, fuhr, gefahren, *drive.* About 10 verbs.

c. Vowels **a-ie** *or* **i-a**, fallen, fiel, gefallen, *fall;* fangen, fing, gefangen, *catch.* About 16 verbs.

d. Vowels **a, au, u** *or* **o-ie-au, u** *or* **o**, 4 verbs—laufen, lief, gelaufen, *run;* rufen, rief, gerufen, *call;* ſtoßen, ſtieß, geſtoßen *knock;* hauen, hieb, gehauen, *hew.*

Class 3

a. Vowels **ei-i-i**, beißen, biß, gebiſſen, *bite.* About 22 verbs.

b. Vowels **ei-ie-ie**, ſchreiben, ſchrieb, geſchrieben, *write.* About 16 verbs.

c. Vowels **ie** *or* **ü-o-o**, biegen, bog, gebogen, *bend.* About 24 verbs, of which 3 have the vowel ü, viz. küren, kor, gekoren, *choose;* lügen, log, gelogen, *lie* (tell falsehoods); trügen, trog, getrogen *deceive.*

d. Vowels **au-o-o**, 4 verbs—ſaufen, ſoff, geſoffen, *swill;* ſaugen, ſog, geſogen, *suck;* ſchnauben, ſchnob, geſchnoben, *snort;* ſchrauben, ſchrob, geſchroben, *screw.*

e. Vowels **i, e, ä, ö,** *or* **a-o-o**, about 20 verbs—klimmen, klomm, geklommen, *climb;* heben, hob, gehoben, *lift;* gären, gohr, gegohren, *ferment;* ſchwören, ſchwor, geſchworen, *swear;* ſchallen, ſcholl, geſchollen, *sound.*

f. Vowels **i-u-u**, 2 verbs—ſchinden, ſchund, geſchunden, *flay;* dingen, dung, gedungen, *engage, hire.*

Five verbs are quite irregular; they are: kommen, kam, gekommen, *come,* which originally belonged to 1 *c;* heißen, hieß, geheißen, *be called,* originally 3 *b;* gehen, ging, gegangen *go, walk,* originally 3 *c;* ſtehen, ſtand, geſtanden, *stand,* originally 2 *f;* tun, tat, getan, *do.*

The student should note the following irregularities:—

Pres. Ind. 2nd and 3rd pers. are subject to the following changes of the stem vowel of the Pres.:—

Verbs having the stem vowel e change e into i or ie; if the e of the stem is short it changes to i, and if the e is long it changes to ie. Thus ich eſſe, *I eat,* du ißeſt, er ißt, ich ſehe, du ſiehſt, er ſieht. However, three verbs have a long e in the stem and take i in the 2nd and 3rd pers., namely, nehmen, du nimmſt, *to take,* geben, *to give* (which has alternative forms with ie), and treten, *to tread,* du trittſt.

A few verbs retain the e of the stem; the commonest of these are gehen, ſtehen, heben, and geneſen, *to get well.*

Most verbs with the stem vowel a modify the a in the 2nd and 3rd pers. sing.

A number of these verbs which change their vowel and which end in d or t, do not add et in the 3rd pers. sing. as we should expect, but drop the ending altogether. Thus, werden, er wird, halten, er hält, etc.

Since the Pret. is formed (as far as the 1st and 3rd pers. sing. are concerned) without any termination, it normally ends in the same consonant as the Pres. stem; but some verbs that have a double consonant in the Pres., and hence a short vowel, have a long vowel in the Pret., and in that case the double consonant is simplified. Thus treffen, *to meet,* ich traf, *I met.*

On the other hand, some verbs have a single consonant, and hence a long vowel in the Pres. and a short vowel in the Pret., and then the consonant is doubled in the latter. Thus ſchneiden, *to cut,* ich ſchnitt, *I cut.*

Again, verbs which change e to i or ie in the 2nd pers. sing. Pres. Ind. keep the i or ie in the 2nd pers. sing. of the Imperat. and do not add the ending e.

Verbs which modify a to ä in the 2nd pers. sing. Pres. Ind. do not modify in the Imperat.

We shall deal later on in detail with verbs which have separable prefixes, but there is

one point about them that the student must grasp at this stage, since these verbs are of such frequent occurrence. Such verbs are compounds of ordinary verbs with certain prepositions and adverbs prefixed, e.g. mit'nehmen, *to take with;* an'kommen, *to arrive.*

The prefix stands before the verb proper in the Infinitive and the Participles; in the Past Part. the ge is placed between the prefix and the verb, and when the Infin. is used with zu this is also put between the prefix and the verb. Thus, mitgenommen, anzukommen. In all principal clauses, whether the order of the verb and subject be inverted or not, the prefix is used as a separate word and is placed after the finite part, of the verb at the end of the clause. Thus, Er nahm mich mit, *he took me with* (him); Wann komme ich an? *when do I arrive?* Further, in these verbs the accent always falls on the separable prefix.

VOCABULARY

(The numbers after the verbs refer to the classes of strong verbs.)

ich weiß, *I know.*
bedeuten, *to mean.*
Märchen, s.n. 1, *fairy tale.*
kühl, *cool.*
ruhig *quiet, calm.*
Rhein, *the Rhine.*
funkeln, *to sparkle.*
Sonnenschein, s.m. 3, *sunshine.*
wunderbar, *wonderful.*
Geschmeide, s.n. 1, *jewels.*
kämmen, *to comb.*
Kamm s.m. 2, *comb.*
wundersam, *marvellous.*
Melodei, w.f., *melody.*
Schiff, s.n. 2, *ship, boat.*
wild, *wild.*
schauen, *to see, look at.*
Riff, s.n. 2, *reef.*
Höhe, w.f., *height.*
Ende, w.n., *end.*
Welle, w.f., *wave.*
es soll, *it shall, it ought.*
traurig. *sad.*
Luft, s.f. 2, *air.*
dunkeln, *to grow dark.*
fließen 3c., *to flow.*
Gipfel, s.m. 1, *summit.*
Abend, s.m. 2, *evening.*
Jungfrau w.f., *maiden.*
golden *golden.*
blitzen, *flash.*
Haar, s.n. 2, *hair.*
dabei, *therewith.*
gewaltig, *powerful.*
Schiffer, s.m. 1, *boatman.*
ergreifen, 3a, *seize.*
Weh, s.n. 1, *pain, sorrow.*
Fels, s.w.m., *rock.*
hinauf, *upwards.*
glauben, *to believe.*
verschlingen, 1a, *to swallow.*
Kahn, s.m. 2, *small boat.*

Exercise 21

Ich weiß nicht, was soll es bedeuten',
Daß ich so traurig bin;
Ein Märchen aus[2] alten Zeiten,
Das[3] kommt mir[4] nicht aus dem Sinn.

Die Luft ist kühl und es dunkelt[5],
Und ruhig[6] fließt der Rhein;
Der Gipfel des Berges funkelt,
Im Abendsonnenschein.[7]

Die schönste Jungfrau sitzet[8]
Dort oben wunderbar,
Ihr goldnes[9] Geschmeide[10] blitzet,
Sie kämmt ihr goldenes[9] Haar.

Sie kämmt es mit goldenem[9] Kamme,
Und singt ein Lied dabei;[11]
Das[12] hat eine wundersame,
Gewaltige Melodei.[13]

Den Schiffer in kleinem Schiffe,
Ergreift[14] es mit wildem Weh;
Er schaut[15] nicht die Felsenriffe,
Er schaut[15] nur hinauf in die Höh[16].

Ich glaube, die Wellen verschlingen[17]
Am Ende Schiffer und Kahn;
Und das hat mit ihrem Singen[18]
Die Lorelei[19] getan.

Heine.

NOTES:

(1) was soll es bedeuten—this is an indirect question, i.e. a dependent clause, and therefore we should expect the finite verb soll to be placed at the end, but the poet has retained the order of the direct question. (2) aus as a prep.; aus always governs the dat. (3) das, demons. pron. refers to Märchen. (4) mir dat. of advantage. (5) es dunkelt—this is an impersonal verb. (6) ruhig, adjective used as an adverb. (7) Abendsonnenschein—this is a compound noun very characteristic of the way in which the Germans put words together. It takes the gender of, and is declined according to, the last component, Schein, which means *light, brightness.* The second component Sonne is a weak fem. noun, and all these weak nouns used to take the termination n in all the oblique cases of the sing. The mas. and neut. nouns still retain the n, but the fem. nouns have dropped it in the sing.; yet it survives in some compounds, and Sonnen here is the old gen. case. Hence the word means *evening light of the sun,* i.e. evening sunshine. In Felsenriffe (l. 19) the first part of the compound is gen. plur. (8) sitzet, blitzet—in prose these would be sitzt, blitzt, but the fuller forms are retained here on account of the metre. (9) Golden—this adj. can drop the e of the derivative ending (it is formed from Gold, s.n., *gold*) before the e of the case endings. This unaccented e is dropped or retained according to the exigencies of the metre. (10) Geschmeide—this, like most neut. nouns with the prefix ge, is a collective and has no plur. (11) dabei, i.e. *with it* (see note 12, Ex. 19). (12) das, demons. pron., refers to Lied. (13) Melodei—the modern form of this is Melodie (14) Ergreift es—this impers. construction is equivalent to a passive voice, i.e. *is seized.* (15) Schaut is used transitively in the first line and intransitively in the second. (16) Höh—the full form of this is Höhe but the e is dropped on account of the rhyme. The student will notice that this rhyme is not pure; rhymes between e and ö and between i and ü are common in German. (17) verschlingen—this is a dependent clause, and we should expect the verb to come at the end, i.e. after Kahn; its position is changed on account of the rhyme. (18) Singen—this is the Pres. Infin. of a verb used as a Neut. noun. (19) Die Lorelei—the def. art. is frequently used with proper names.

Exercise 22

1. Account for the position of the verb bin in line 2, and for the Past Part. getan in line 24. 2. Give the Infin., Past Part., and the whole of the Ind. Pres. and Pret. and the past Conj. of the following: kommt l. 4, fließt l. 6, ſitzet l. 9, blitzet l. 11, ſingt l. 14, ergreift l. 18, verſchlingen, l. 21. Account for the case of the following: Sinn l. 4, Berges l. 7, Haar l. 12, Kamme l. 13, Schiffer l. 17, Höh l. 20, das l. 23.

Translate the following into German:—

He heard an old fairy tale about (von) a beautiful maiden who lived on a rock in the Rhine. She had golden hair which she combed with a golden comb, and she sang songs which had a marvellous melody. This melody bewitched (bezaubern) the boatmen in their little boats; they gazed upwards and did not see the rocks. Then the waves swallowed up the boatmen and their boats; they died (ſterben 1c) because the beautiful maiden, Lorelei, with her flashing jewels, her golden hair, and her marvellous songs, had bewitched them.

Key to Exercise 16

A rich man was ill for a long time, and he was astonished because some of his friends did not visit him at all. Then he said to his steward (man of affairs), "They do not dare to come because they owe you money, and they are not in a position to pay." Thereupon the man answered, "Tell them they do not owe me anything any more (they owe me nothing more), and that I ask them to come to me in order to fetch their receipts. I prefer to lose my money to losing my friends (I lose rather my money than my friends).

NOTE:—The words in brackets give the literal translation. The student should grow accustomed from the beginning to translating into good English, but, of course, it is important that he should realise what the literal translation is.

Key to Exercise 17

1. ihn is acc. sing. of the mas. pers. pron. mas. sing. governed by the trans. verb besuchten. Ihnen is 2nd pers. pron. sing. (plur. in form) dat. governed by the verb schulden. Stande is dat. sing. governed by the prep. in. Quittungen is acc. plur. governed by the trans. verb holen. Freunde is acc. plur. governed by the trans. verb verlieren.

2. Diese Frau war lange Zeit krank und sie war reich. Sie waren erstaunt weil ich sie nicht besuchte. Jener Mann war nicht im Stande zu kommen. Sagen Sie ihr dasz ich krank bin. Er sagt dasz ich mein Geld verliere. Sie werden müde sein. Sie werden viele Freunde haben. Sie hatte die Bücher die sie holten.

Key to Exercise 18

1. Pres. Ind., 1st pers. sing.,—ich lebe, lege, ſchicke, liebe, neige, zeige, koche, führe; 1st pers. plur, wir leben, legen, ſchicken, lieben, neigen, zeigen, kochen, führen.

Pret., 1st pers. sing..—ich lebte, legte, ſchickte, liebte, neigte, zeigte, kochte, führte; 1st pers. plur., wir lebten, legten, ſchickten, liebten, neigten, zeigten, kochten, führten.

Future, 1st pers. sing.,—ich werde leben, legen, ſchicken, lieben, neigen, zeigen, kochen, führen; 1st pers. plur. wir werden leben, legen, ſchicken, etc.

2. Pres. Conj., 2nd pers. sing.,—du lebeſt, legeſt, ſchickeſt, etc.

3rd pers. sing.,—er lebe, lege, ſchicke, liebe, etc.

Past Conj. 3rd pers. plur.,—ſie lebten, legten, ſchickten, etc. Alt. Form, ſie würden leben, legen, ſchicken, etc.

Future Conj., 3rd pers. sing., er werde leben legen, ſchicken, etc.

Comp.				*Superl.*	
größer	der,	die,	das	größte	am größten
beſſer	„	„	„	beſte	„ beſten
kleiner	„	„	„	kleinſte	„ kleinſten
röter	„	„	„	röteſte	„ röteſten
ſchöner	„	„	„	ſchönſte	„ ſchönſten
häßlicher	„	„	„	häßlichſte	„ häßlichſten
zahmer	„	„	„	zahmſte	„ zahmſten
hohler	„	„	„	hohlſte	„ hohlſten
länger	„	„	„	längſte	„ längſten
höher	„	„	„	höchſte	„ höchſten
kürzer	„	„	„	kurzeſte	„ kürzeſten
billiger	„	„	„	billigſte	„ billigſten
teuerer	„	„	„	teuerſte	„ teuerſten
mächtiger	„	„	„	mächtigſte	„ mächtigſten
dünner	„	„	„	dünnſte	„ dünnſten
dicker	„	„	„	dickſte	„ dickſten
ſüßer	„	„	„	ſüßeſte	„ ſüßeſten

Key to Exercise 19

Alexander the Great once came to Corinth and visited Diogenes there. He found him in the neighbourhood of a forest, where he was sitting beside his barrel and sunning himself. Alexander said to him, "I am the great king Alexander." "And I," answered the philosopher, "am the dog Diogenes." 'Are you not afraid of me (have you not fear before me)?" asked the king. "Are you a good or a bad man?" replied Diogenes. "I am good," said Alexander. "Who would be afraid of a good man?" answered the philosopher. After a somewhat long conversation the great king said, "I see that you lack many things (that many things are wanting to you): I should be glad to have an opportunity to help you. Ask of me what you will." Thereupon Diogenes replied, "I beg you to move, as you are standing between me and the rays of the sun (I beg you to go out of the sun for me)." Alexander was highly astonished to see a man who was so far superior to all human desires (who stood so far above every human need). Diogenes continued: "Which (who) of us two (both) is the happier, he who is satisfied with his cloak and his barrel, or he whom a whole kingdom does not suffice and who continually strives to enlarge it (strives after it, to enlarge it)?"

Key to Exercise 20

(1) Wir kamen nach Korinth und beſuchten einen Mann dort. (2) Dieſes Haus iſt in der Nähe eines Waldes wo viele große Bäume ſind. (3) Wir ſchickten der häßlichen Frau die neben dem dicken Kind ſaß ein kleines Buch.
(Note that in the foregoing the indirect object and the clause which qualifies it precede the direct object.)
(4) Ich ſehe das Sie eine lange Unterhaltung mit der Schweſter jenes Philoſophen hatten. (5) Ich hörte daß ſie krank geweſen war, und ich freue mich daß ſie im Garten ſaß und ſich ſonnte. (6) Dieſes genügt Ihnen nicht. ich werde Ihnen mehr ſchicken. (7) Sie waren höchſt erſtaunt weil er kam. (8) Er iſt glücklicher als ſie. (9) Er war mit ſeinem Sohn zufrieden. (10) Wir würden uns freuen in dem Garten zu ſpielen. (11) Wer von dieſen beiden Männern iſt der beſſere?

M. A. L.

RUSSIAN.—I *

THIS course does not aim at teaching the Russian language thoroughly. Its object is to put before the clerk or business man, totally ignorant of that tongue, what he absolutely requires for daily commercial purposes.

The notion which prevails regarding the difficulties of the Russian language is to a large extent without foundation. The bogy of strange characters is easily laid to rest after a few hours' study of the letters as written and printed—that is to say, after mastering the first few lessons of this Commercial Course; and once the student becomes familiar with the letters, he can begin for himself to decipher and pronounce this euphonic language, for as soon as the rules for pronunciation are learned the rest is easy. Exceptions are few; and the construction of the language is very like the Romance tongues and certainly simplicity itself as compared with German, with its difficult declensions and conjugations.

The Russian verbal tenses, for example, comprise only three simple forms:—present, past and future, (1) I say, (2) I said, (3) I shall say.

The compound tenses do not exist in a separate form, such as "I have said, had said, shall have said," but prepositional prefixes and slight modifications in the body of the verb produce the so-called aspects, whereby a rich variety of expression is given to this part of speech, a feature shared in common with the other Slav languages.

Alphabet

Written. Cap.	Written. Small.	Printed. Cap.	Printed. Small.	Name.	Like.	In.
A	*a*	A	a	ah	a	pat
Б	*б*	Б	б	bay	b	bed
В	*в*	В	в	vay	v	vain
Г	*г*	Г	г	gay (*always hard*)	g	good
Д	*д, g*	Д	д	day	d	done
Е	*е*	Е	е	yay	ye	yet
Ж	*ж*	Ж	ж	zhay	s	measure
З	*з*	З	з	zay	z	zeal
И	*и*	И	и	ee	i	machine
І	*і*	І	і	ees-tochkoi (*with a dot*)	i	machine
Й	*й*	Й	й	ees-kratkoi (*with a curve*)	i	pit
К	*к*	К	к	kah	k	make
Л	*л*	Л	л	ell	l	lee
М	*м*	М	м	emm	m	may
Н	*н*	Н	н	enn	n	nay
О	*о*	О	о	oh	o	no
П	*п*	П	п	pay	p	pot
Р	*р*	Р	р	airr	r	rough
С	*с*	С	с	ess	s	soon (*never like z*)
Т	*т*	Т	т	tay	t	talk
У	*у*	У	у	oo	u	rule
Ф	*ф*	Ф	ф	eff	f	fine
Х	*х*	Х	х	kh (*guttural*)	ch (*Scotch*)	loch
Ц	*ц*	Ц	ц	tsay	ts	flotsam
Ч	*ч*	Ч	ч	chay	ch	church
Ш	*ш*	Ш	ш	shah	sh	shun
Щ	*щ*	Щ	щ	shchah	shch	cash-chest
Ъ	*ъ*	Ъ	ъ	yairr, or tvyordy znak (*hard sign*)*		
Ы	*ы*	Ы	ы	yairru	u-ee	ui (as in French *fruit*)
Ь	*ь*	Ь	ь	yair, or myakhkee znak (*soft sign*)†		
Ѣ	*ѣ*	Ѣ	ѣ	yat'	ye	yet
Э	*э*	Э	э	e (*short*)	e	men
Ю	*ю*	Ю	ю	yoo	yu	yule
Я	*я*	Я	я	yah	ya	yard
Ѳ	*ѳ*	Ѳ	ѳ	feeta	f	foe
Ѵ	*ѵ*	Ѵ	ѵ	ee'zhitsa	v	dove

N.B.—The last two are not used in modern Russian.

* Thanks are due to Mr. Alexander Levine for kind assistance in revising proofs, etc.

* Hardens preceding consonant.
† Softens preceding consonant.

Reading and Writing Exercises

Азбука А. Азбука (áz-bu-ka), *the A B C.*

аршинъ а. аршúнъ (ar-shín), *the arshin.* (= 28 inches)

Бумага Б. Бумáга (bu-má-ga), *paper, cotton.*

бѣлье б. бѣльё (byel'-yó), *linen, underclothing.*

Вода В. Водá (va-dá), *water.*

вѣсъ в. вѣсъ (vyes), *weight.*

Годъ Г. Годъ (got), *year.*

гранъ г. гранъ (gran), *the weight of a grain.*

Дѣло Д. Дѣло (dyé-lo), *business, deed, action.*

деньги д. дéньги (dyén-gi *), *money.*

Ель Е. Ель (yel' †), *fir tree.*

если е. éсли (yés-li), *if, in case.*

Жизнь Ж. Жизнь (zhizn' ‡), *life.*

желѣзо ж. желѣзо (zhe-lyé-zo), *iron.*

Законъ З. Закóнъ (za-kón), *law.*

зонтикъ з. зóнтикъ (zón-tik), *umbrella.*

Икра И. Икрá (i-krá), *caviar.*

искать и. искáть (i-skát'), *to look for, seek, claim.*

Іюль І. Іюль (i-yúl'), *July.*

іодъ і. іодъ (ió t), *iodine.*

Николай Второй Й. НИКОЛÁЙ (ni-kolái), ВТОРÓЙ (ftaróï), *Nicholas the Second.*

копѣйка й. копѣйка (ka - pyéi - ka), *copeck.*

Казначейство К. Казначéйство (kaz - na - chéĭst - vo), *the exchequer.*

книга к. книгá (kní-ga), *book.*

Ленъ Л. Лёнъ (l-yón), *flax.*

лавка л. лáвка (láf-ka), *shop, bench, form.*

* *g* is always hard, as in *get.*

† The apostrophe after a consonant signifies that the consonant is softened by adding the sound of *y* in the English word *ye.*

‡ zh = *s* in *measure.*

Москва М. Москвá (mask-vá), *Moscow.*

мыло м. мы́ло (mwü-lo), *soap.*

Недѣля Н. Недѣля (nye-dyé-lya), *week.*

новость н. новость (nó-vost'), *novelty, news.*

Остатокъ О. Остáтокъ (as-tá-tok), *remnant, balance.*

одинъ о. одúнъ (a-dín), *one, self, single.*

Пакетъ П. Пакéтъ, (pa-kyét), *packet, parcel.*

пара п. пáра (pá-ra), *a pair, couple, match.*

Рубль Р. Рубль (rubl'), *a rouble.*

росписка р. роспúска (ras-pís-ka), *receipt, promissory note.*

Счетъ С. Счётъ (s-chót), *invoice, account.*

срокъ с. срокъ (srok), *term, due, date, grace.*

Товаръ Т. Товáръ (ta-vár), *goods, ware, merchandise.*

тарифъ т. тарúфъ (ta-rif), *tariff.*

Учетъ У. Учётъ (u-chót), *discount.*

узоръ у. узóръ (u-zór), *design.*

Фарфоръ Ф. Фарфóръ (far-fór), *porcelain.*

форма ф. фóрма (fór-ma), *form, shape, mould.*

Холстъ Х. Холстъ (kholst), *linen, cloth.*

хорошо х. хорошó (kha-ra-shó), *good, well, nice, all right.*

Царь Ц. Царь (tsar'), *the Czar.*

цвѣтъ ц. цвѣтъ (tsvyet), *the shade, colour, tint, flower, blossom.*

Чай Ч. Чай (chaĭ), *tea.*

часть ч. часть (chast'), *a part, portion.*

Шерсть Ш. Шерсть (sherst'), *wool.*

шоколадъ ш. шоколáдъ (sha - ka - lát), *chocolate.*

Щетина Щ. Щетúна (shche-tí-na), *a bristle.*

щетка щ. щётка (shchót-ka), *a brush.*

Богъ Ъ. БОГЪ (bokh), *God.*

миръ ъ. миръ (mir), *peace.*

Господь Ь. ГОСПО́ДЬ (gas-pód'), *the Lord.*

Государь ь. Госуда́рь (ga-su-dár'), *sir, sovereign.*

Милостивый Ы. МИЛОСТИ́ВЫЙ (mi-los-tí-vwüĭ), *dear, gracious.*

покорный ы. поко́рный (pa-kór-nüĭ), *humble, obedient.*

Ѣхать Ѣ. Ѣхать (yé-khat'), *to make a journey to.*

ѣсть ѣ ѣсть (yest'), *to eat.*

Электричество Э. Электри́чество (ĕ-lyek-trí-chest-vo), *electricity.*

экономія э. эконо́мія (ĕ-ka-nó-mi-ya), *economy.*

Югъ Ю. Югъ (yuk), *the south.*

ювелиръ ю. ювели́ръ (yu-vye-lír), *a jeweller.*

Ярлыкъ Я. Ярлы́къ (yar-lŭk), *ticket, label.*

ящикъ я. я́щикъ (yá-shchik), *box, case, chest.*

Ѳома Ѳ. Ѳома́ (fa-má), *Thomas, Tom.*

миѳъ ѳ. миѳъ (mif), *myth.*

Иссопъ V. Иссо́пъ (is-sóp), *hyssop.*

ипостась v. ипоста́сь (i-pas-tás'), *hypostasis.*

The student is recommended to make up a handy dictionary of the Russian words he meets with in this course.

Vowels

Hard :—

а, pronounced *a* (in *pat*).
о, pronounced *o* (in *pot*).
у, pronounced *u* (always long, as in *flute*).
ы, pronounced *ui* (as in French *fruit*).

Corresponding *soft :—*

я. pronounced *ya*.
е (ё), pronounced *yay* (*yo*).
ю, pronounced *yu*.
и, pronounced *i* (always long).
і is short, and we mark it *i*.

Memorise thus :—

Hard.	*Soft.*
а	я
о	е
у	ю
ы	и, і

The letter о is pronounced *a* in any syllable before the accented one, as: Това́ръ (ta-vár), *goods ;* Голова́ (ga-la-vá), *head.*

The vowel ё is pronounced *yo*—this is the sound е assumes when it receives the accent accidentally.

Consonants

Hard :	Corresponding *soft :*
п	б
ф	в
к	г
т	д
ш	ж
с	з

Soft consonants, as above, when immediately preceding ъ (hard sign) or any hard consonant, take the corresponding hard sound in pronunciation. Therefore, in such cases the sound of б is heard as п ; of в, as ф ; of г, as к ; of д, as т ; of ж, as ш ; of з, as с.

Examples

Коро́бка	(ka-rób-ka),	*a small box.*
Ла́вка	(láf-ka),	*a shop, form, bench.*
Магнези́я	(mag-nyé-zee-ya),	*magnesia.*
Подши́вка	(pat-shíf-ka),	*lining.*
Тя́жко	(tyásh-ko),	*it is hard, heavy.*
Бли́зко	(blís-ko),	*near, nearly.*

Laws of Permutation

(For reference only)

1.—*Consonants*

(1) г, д, з, become ж before
(2) к, т, ц, „ ч „
(3) х, с, „ ш „
(4) ск, ст, „ щ „
} я, е, и, ю, ь

2.—*Vowels*

(1) я after
(2) ю „
} г, к, х, ж, ч, ш, щ, ц, { becomes а / „ у
(3) ы „ г, к, х, ж, ч, ш, щ „ и
(4) о (unaccented) after ж, ч, ш, щ, ц, „ е
(5) ѣ after і, „ и
(6) и before another vowel, „ і
(7) ю, when preceded by б, в, м, п, ф, inserts л in first person, present indicative of verbs, as люблю́ (lyub-lyú), *I love.*

3.—*Semi-vowels*

(hard and soft signs and й)

(1) ь after a vowel, becomes й
(2) ь before a consonant with ч becomes е
(3) ъ „ two consonants „ о
(4) й „ a consonant with ъ „ е
(5) ъ and ь only stand after consonants.

These rules on permutation will at a later stage be found very useful in explaining the changes that take place through declension, conjugation, and other causes. A. C.

Continued from page 43.

GEOGRAPHY:

Contributors:—**Robert Finch, F.R.G.S.; W. H. Koebel; Sir John Scott-Keltie, LL.D.; Cyril J. Silverston, B.Sc.(Lond.).**

SHORES AND COASTLINES

THE coast of a continent or country is that portion of the land partly above and partly below the mean sea level which is subjected to the action of the sea. It has been noticed, though whether the facts have any particular significance or not is uncertain, that the coasts of the world's continents run either more or less in the direction N.E.–S.W. or at right angles to this direction, viz., N.W.–S.E. An inspection of the map will bring out this fact very clearly. A North and South coastline and an East and West coastline of any considerable extent are quite uncommon.

The coastal belt is by no means constant when viewed throughout long periods of time. It is constantly being altered by the raising or lowering of the land or possibly by changes in the volume of the ocean. Evidence of this is very common in the "raised beaches" and "submarine forests" found at various parts around the British Isles. In classifying the various forms of coasts we must distinguish between those that have been raised above and those that have been depressed below the surface of the sea in more or less recent times.

Sunken Coasts

The characteristic features of Sunken Coasts are naturally determined by the character of the land that has been depressed. If the rocks comprising the land were originally folded at right angles to the present coastline we get long, narrow inlets at right angles to the shore gradually narrowing as they pass inland. This is the characteristic of a *ria* coast, a term derived from the name given to such inlets in the coast of the north of Spain which gradually narrow and shallow from their outlet to the head. The sea has worn away the softer rocks and left outstanding those which offer a greater resistance. (Fig. 30.)

If the regions now sunk beneath the sea have been glaciated showing the typical U-shaped valley of ice origin, we get a fiord where the inlet is steep-sided, does not narrow much, and has an irregular floor. These are generally shallower at the outlet than further inland owing to the deposit of morainic accumulations. Such a coast may be fringed with islands showing ice action, as is seen in the Norway coast (whence the term fiord is derived) and also in many of the lochs of Scotland. (Fig. 29.)

If, on the other hand, the rocks of the land have been folded in a direction parallel to the coast, inlets are few, and such as they are have the shape of a "T" or "L." They have usually a narrow entrance formed by a drowned transverse valley which widens out into the longitudinal valley of the old land. In this case, too, chains of islands may be found along the coast, as is very clearly marked on the east of the Adriatic Sea along the Dalmatian coast.

Raised Coasts

Raised Coasts are more or less regular with gentle curves, frequently sandy, and often bordered by dunes or grass-grown sand-hills. A common feature in a raised coast is the formation of lagoons usually parallel to the shore and separated from it by a sand or pebble bank. These lagoons are formed by currents of the sea, tides, or rivers.

In many tropical parts of the African continent another form of coast is found caused by the formation of huge mangrove swamps, and in Australia, on the east coast, the coral polyp has built up by the remains of its skeletons a huge barrier reef of very characteristic appearance.

The smaller forms of coast relief are mostly found on sunken coasts where the action of the waves has been able to transform the appearance of the land fringe. Here the varying composition and structure of the rocks determine the shapes of the coast. A homogeneous rock forms a coast of regular outline; if rocks of varying hardness are present bold headlands may alternate with sandy coves. If the rocks show horizontal

bedding and vertical jointing we shall probably get perpendicular cliffs with isolated "needles" standing out in the sea near by. From the foot of cliffs there often extends seawards a nearly flat platform or terrace cut by the waves as the cliffs were worn back. (Fig. 31.)

Waves act on a coast to a depth of about 60 feet, and if no further sinking of the earth takes place the shore tends to become shallower owing to the shore deposits which

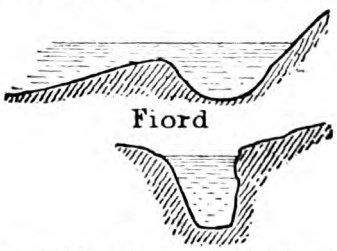


Fig. 29.—A Fiord is a steep-sided inlet which does not narrow much and has an irregular floor.

accumulate. Currents in the sea act to a depth of some 300 feet, and may carry sand or pebbles and deposit them in quiet waters under the lee of some headland or island. This forms a pebble spit, of which an excellent example is seen in the Chesil Beach in Dorsetshire on the South Coast of England. Territorial waters are usually considered as being all waters within three nautical miles of a coast measured from low-water mark.

The Ocean is a continuous body of water covering nearly three-quarters of the face of the earth (see Vol. I., page 297). Its

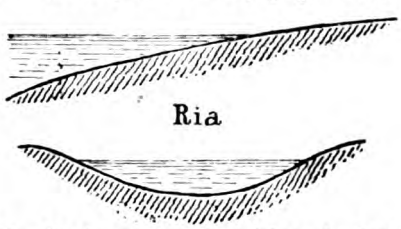


Fig. 30.—If the rocks comprising the land were originally folded at right angles to the present coastline, narrow inlets at right angles to the shore result. This is termed a *ria* coast.

average depth is between eleven and twelve thousand feet, the greatest depth being about 31,000 feet, measured near the island of Guam. This depth can be compared with the greatest height of the land in Mount Everest, which is about 29,000 feet. We also notice that the average depth of the ocean is considerably greater than the average height of the land, which is about 2,300 feet.

The waters of the ocean contain in solution various salts, the chief among which is chloride of sodium or common salt, which is dissolved to the extent of 27 parts in 1,000 of water. Other salts held in solution are the chlorides of magnesium and potassium, sulphates of magnesium and calcium, and certain carbonates, etc. Though its composition is fairly uniform, we find in certain districts where evaporation is greater there is an increase in the solids contained in it, and, on the other hand, where, near a large river or in the neighbourhood of icebergs, a large quantity of fresh water is added to the ocean the proportion of dissolved salts is rather less.

Ocean waters are usually blue in colour, but vary locally. The Yellow Sea, for example, is so called from its colour owing to particles held in suspension; and innumerable microscopic animals give a reddish tinge to the waters of the Red Sea.

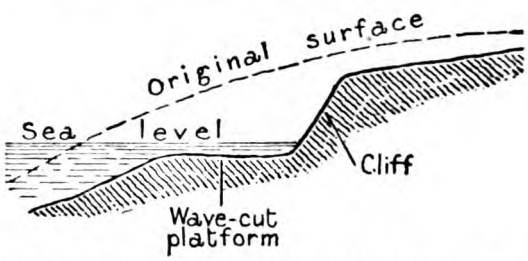


Fig. 31.—From the foot of cliffs there often extends seawards a nearly flat platform cut by the waves as the cliffs were worn back.

When it freezes the ice formed is nearly fresh, the dissolved salts being largely left behind in the water. The density or weight of the water is the chief factor which determines the motion of the ocean, as evidenced in the deep sea currents as distinguished from the surface currents. It is found that the density diminishes as we get towards the Poles. Surface currents are, however, caused by the prevailing winds, but these will be discussed later.

Although, as we have seen, the surface of the sea is continuous, the continents and islands divide it roughly into three great areas, and to these are given the names of Oceans. These are the Atlantic, the Pacific, and the Indian Oceans.

The Pacific Ocean is the largest, having an area of 64 million square miles. It is of the greatest average depth of all the oceans, and contains the deepest depression that has been discovered. Its coastline is under 50,000 miles long.

The Atlantic is bounded on the west by America, and on the east by Europe and Africa; Greenland forms a wedge in its northern extent. The Pacific is bounded on the west by Asia and Australia, and on the east by America. The Indian Ocean is bounded by Africa on the west, Asia on the north, and Australia on the east.

Besides these three great areas, the waters included by the Polar circles are respectively known as the Arctic and Antarctic Oceans, but their boundaries are really not distinct from the other oceans.

Deep-sea soundings have established the fact that in the neighbourhood of the continents the ocean is comparatively shallow, and for some distance from the land does not exceed about 600 feet. This portion of the ocean floor is known as the Continental Shelf. Beyond this line the descent is much steeper, and there is usually a fairly sudden drop into the greater depths.

Owing to the fact that it is protected by the water from the weathering action of atmospheric agencies, the floor of the sea has a more or less regular surface comprising no abrupt heights such as are found on the land surface. At the same time, a glance at a map designed to show the depths of the ocean (a bathy-orographical map) will show that it is far from being absolutely level. In the Atlantic Ocean, for instance, we see a well-defined ridge running down the middle more or less following the direction of the American continent, and it is on or near this ridge that most of the few isolated islands of this ocean are found to be situated.

Near to the land the bed of the sea consists of materials derived from the shore. These consist of pebbles, sand, and, further out where the water is undisturbed by wave-action, of mud. As we leave the continental shelf and descend into the ocean depths, this gives way to what are known as the Pelagic Deposits, which consist mainly of Globigerina Ooze, a deposit formed by the more permanent remains of dead organisms of minute size. As these die their empty shells fall in a sort of rain into the ocean bed, and thus form this deposit. The so-called diatom ooze and radiolarian ooze are deposits of a similar nature. At still greater depths this globigerina ooze passes into a deposit known as the Red Clay, which is the most widely distributed of all the deep-sea deposits. The origin of this is not known for certain, but it is partly, at any rate, formed of particles of volcanic dust.

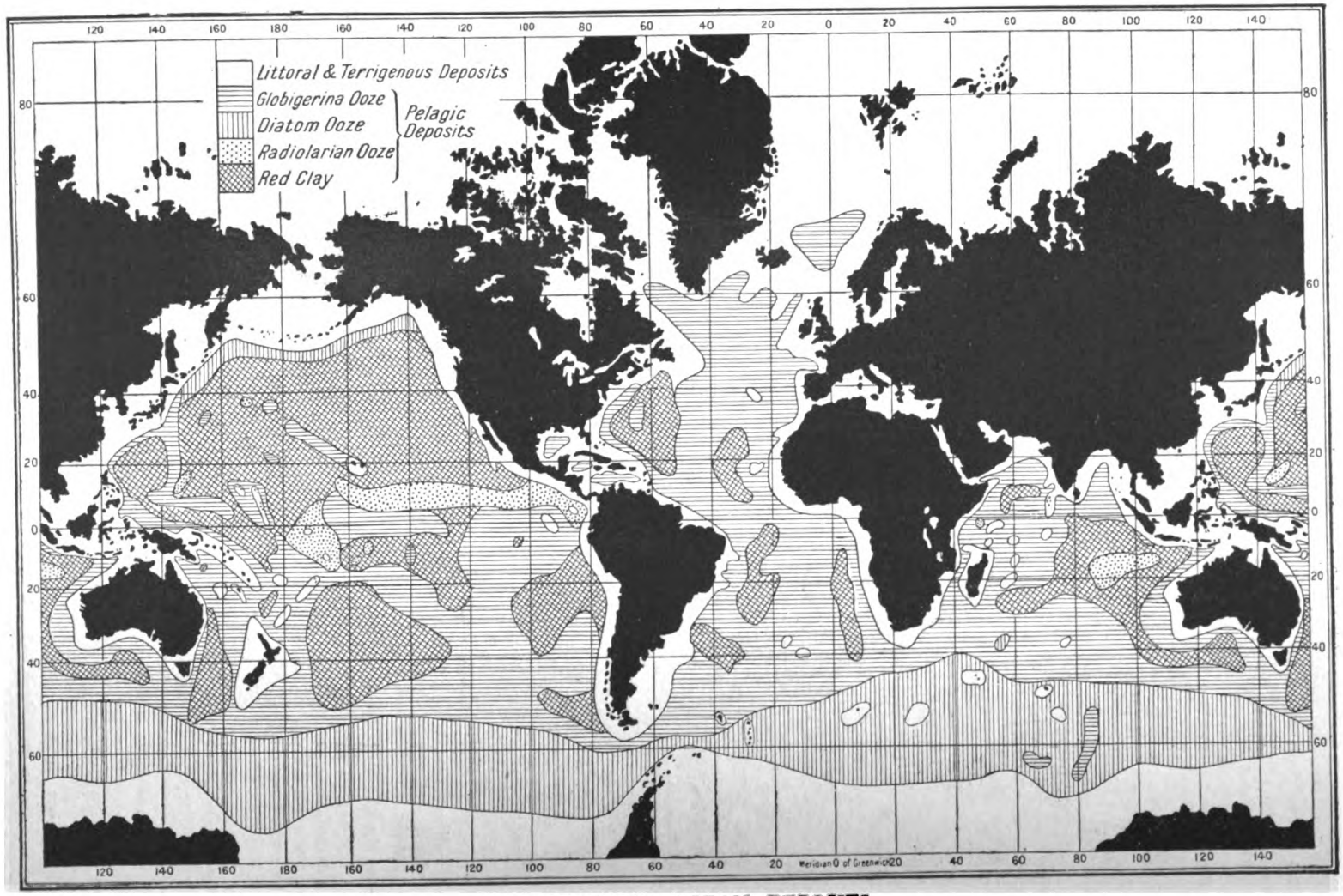
Photo: Frith & Co., Reigate.

THE CHESIL BEACH, ON THE DORSET COAST.

An excellent example of a pebble spit, resulting from the action of waves on a shore that has ceased to sink.

Ocean movements may be of three kinds: waves, tides, and currents.

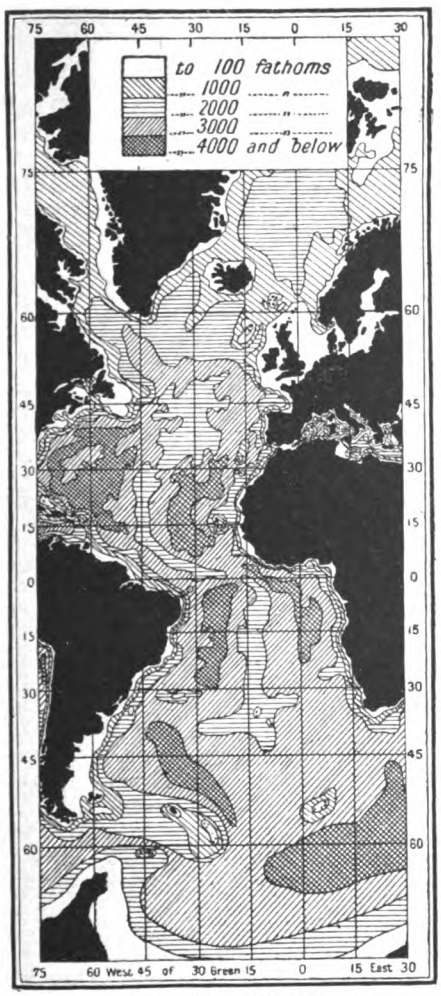
A wave is a movement in any medium which though it seems progressive is in reality only up and down. It is trans-



MAP SHOWING OCEAN DEPOSITS.

Near to the land the bed of the sea consists of materials, such as sand and pebbles, derived from the shore. Beyond the Continental Shelf this gives way to the Pelagic Deposits—Globigerina Ooze, Diatom Ooze, Radiolarian Ooze, and at still greater depths Red Clay.

mitted to a distance by the fact that at each successive point the otherwise similar motion of a single particle takes place a little later in time. We will deal briefly here with the ordinary wave of the ocean



ATLANTIC DEPTHS.

It will be seen that a well defined ridge runs down the middle of the ocean, more or less following the direction of the American continent.

alternately rising into a ridge or crest and sinking into a trough.

A proof that the actual motion of the water in a wave is only up and down is easily seen by the fact that any floating object remains in the same position, merely moving vertically with the passage of succeeding crests and troughs. Even this undulatory movement only affects the water to a depth of a few feet.

Sea waves are mainly caused by the wind. Their height has been greatly exaggerated in the popular imagination, and the expression "mountains high" is apt to give a very misleading idea of the height of waves. The maximum height measured in the Atlantic Ocean is about 60 feet, measured from crest to trough, and even this is very rare.

The origin of tides has been discussed before. We will now consider in more detail their effect on the ocean. The tide is the rise and fall of the sea which takes place twice a day, approximately half an hour later at each tide. The range of the tide is the difference in height between low and high water, and varies, as we know, according to the relative positions of the earth, the moon, and the sun. But it also varies according to the locality. Thus at the head of the Bristol Channel it may be nearly 50 feet in height, whereas on other parts of the coast it may not be more than 4 feet.

The "establishment" of a port is a term used to express the time of high tide on the days of full and new moon. This is always the same, and from it can be calculated the times of high tide for intermediate days.

Tidal Waves

Now, as we have said, a tide is a wave motion of the ocean, and as such is simply a rising and falling of the waters. But when this wave motion reaches shallow waters such as surround the British Isles, it becomes converted into an actual motion of progression and thus forms a tidal stream, which must not be confounded with the true tide. The ebb tidal stream continues running in the same direction for some time after low water has actually been reached, and the flood stream continues running for some time after high water has been reached. These tidal streams tend to sweep ships along with them, and may be a considerable source of danger to navigation.

The tidal waves do not travel round the world with the exact theoretical velocity which we should expect. The reason for this is the varying depth of the water, the shape of the land, and, near the continents, friction with the bed of the sea. Nevertheless there are many places where the time of high tide is always the same, and we can, on a map of the world, join up these places with a line. We thus get a series of *co-tidal* lines showing virtually the progression of the tidal wave. If a co-tidal map of the waters around the British Isles is studied (*see* Vol. I., page 427), a variety of interesting problems will be discovered. C. J. S.

Continued from page 52.

MATHEMATICS:

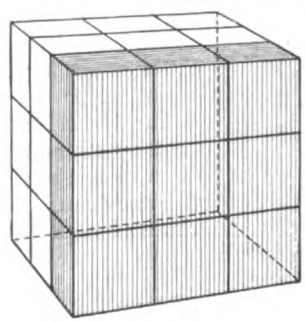
Contributor : — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.

(M. A. Lewenz, M.A.[Lond.]).

ARITHMETIC.—X

Solid or Cubic Measure

88. A **cube** is a solid figure contained by six equal squares.



Suppose the accompanying diagram is a cubic yard, i.e. the cube is contained by 6 faces each consisting of a square yard; and suppose these square yards are divided as before, each into 9 square feet. The shaded part of the diagram shows 9 small cubes, each of whose faces is a square foot, and it is easy to see that 27 of these make up a cubic yard.

$12 \times 12 \times 12 = 1728$ cubic inches make 1 cubic foot.

$3 \times 3 \times 3 = 27$ cubic feet make 1 cubic yard.

89. Measure of Capacity

(*Dry and Liquid*)

4 gills	make	1 pint (pt.)
2 pints	,,	1 quart (qt.)
4 quarts	,,	1 gallon (gal.)
2 gallons	,,	1 peck (pk.)
4 pecks	,,	1 bushel (bush.)
8 bushels	,,	1 quarter (qr.)

Liquids are measured in gills, pints, quarts, and gallons. Solids (corn, etc.) are measured in pecks, bushels, and quarters.

1 gallon of water weighs 10 lb.

Metric Table of Capacity

10 centilitres (cl.)	make	1 decilitre (dl.)
10 decilitres	,,	1 litre (l.) = 1 cubic decimetre
10 litres	,,	1 dekalitre (Dl.)
10 dekalitres	,,	1 hectolitre (hl.)
10 hectolitres	,,	1 kilolitre (kl.) = 1 cubic metre.

90. The **standard unit of Length** is the Imperial Yard. The **standard unit of Weight** is the Imperial Pound (Avoirdupois). The yard is measured by the distance between two marks on a certain metal bar kept in the custody of the Standards Department of the Board of Trade, and the pound is the weight of a certain piece of metal kept at the same place.

The **standard unit of Capacity** is the Imperial Gallon, which contains 10 lb. of distilled water, at a temperature of 62° Fahrenheit.

Exercise 30

Verify the following :—

(1) A decimetre	=	4 inches.
(2) A dekametre	=	11 yards.
(3) A centimetre	=	$\frac{2}{5}$ inch.
(4) A kilometre	=	5 furlongs.
(5) An are	=	120 square yards.
(6) A hectare	=	$2\frac{1}{2}$ acres.
(7) A litre	=	$1\frac{3}{4}$ pints.
(8) A hectolitre	=	22 gallons.
(9) A gramme	=	$15\frac{1}{2}$ grains.
(10) A kilogramme	=	$2\frac{1}{5}$ lb.

Reduction

91. Reduction is a method by which numbers of a higher denomination are expressed in terms of numbers of a lower denomination, and vice versa.

Thus £1 is the same as 240d., and 3 days are the same as 72 hours; and conversely.

The Method of Reduction from a higher denomination to a lower will be made clear by the following examples :—

Examples :—

(1) Reduce £7 14s. 3d. to pence.

There are 20 shillings in £1 $\therefore$ £7 = 7 × 20s. = 140s., and $\therefore$ £7 14s. = (140 + 14)s. = 154s.

Again, there are 12d. in 1s. $\therefore$ 154s. = 154 × 12d. = 1848d., and $\therefore$ £7 14s. 3d. = (1848 + 3)d. = **1851d.**

This is usually written out thus :—

£7 14s. 3d.
20
——
140
+ 14
——
154s.
12
——
1848
+ 3
———
1851d.

(2) Reduce 15 acres 2 roods 25 poles to poles.

15 acres 2 ro. 25 po.
4

62 roods
40

2505 poles.

(Here the addition has been performed mentally.)

(3) How many miles, etc., are there in 7543162 inches ?

In examples of this kind it is more convenient to bring the inches to half-yards (instead of to feet and yards), and then the half-yards to poles, since 11 half-yards make 1 pole.

18 { 3) 7543162 in.
6) 2514387 and 1 in.
11) 419064 half-yds. and 3 × 3 in. } 10 in.
40) 3809,6 poles and 8 half-yds. = 4 yds.
8) 952 fur. and 16 poles
119 miles

119 miles 0 fur. 16 po. 4 yd. 0 ft. 10 in.

(To prove the correctness of this we may reduce the answer to inches.)

(4) How many days, hours, etc., are there in 49875643 sec. ?

60) 49875643 sec.
60) 831260 min. 43 sec.
24 { 4) 13854 hrs. 20 min.
6) 3463—2 hrs.
577 days—1 × 4 hrs. } 6 hrs.

577 days 6 hrs. 20 min. 43 sec.

Exercise 31

Reduce :—

(1) £59 10s. 3d., £14 12s., 8s. 3d., 100 guineas, to pence.

(2) 9s. 4½d., £1 2s., 2s. 9d., £2 0s. 2¾d., to farthings.

(3) £430, 235 guineas, to sixpences.

(4) Find the number of pounds, etc., in 764985107 farthings.

Reduce :—

(5) 15 lb. 10 oz. 4 dwt. 5 gr. to grains, and 28592 grains to lb., etc.

(6) 7 tons, 5 cwt. 1 qr. 14 lb. 8 oz. 7 dr. to drams, and 2005476390 dr. to tons, etc.

(7) 10 qr. 3 bush. 2 pk. 1 gal. 1 pt. 3 gills to gills, and 48721 pt. to bushels.

(8) 7 miles 2 fur. 25 po. 3 yd. 1 ft. 7 in. to inches, and 84900132 in. to miles.

(9) 25 sq. m. 300 ac. 1 ro. 25 sq. po. 15 sq. yd. 2 sq. ft. 100 sq. in. to square inches, and 10000074250 sq. in. to square miles.

(10) Reduce 10 days 5 hr. 45 min. 3 sec. to seconds, and 6450872 sec. to days.

Verify your results by reducing your answers back to the original units.

Compound Addition

92. Compound addition is the method of adding numbers of the same kind but of different denominations. The following examples will show how this is done.

Example :—

Add £3 4s. 7½d., £1 15s. 9¾d., £6 10s. 2d., £1 0s. 11¼d., and 7s. 6¼d.

£	s.	d.	
3	4	7½	
1	15	9¾	
6	10	2	
1	0	11¼	
	7	6¼	
£12	19	0¾	

The sum of 1 farthing and 1 farthing and 3 farthings and 2 farthings = 7 farthings = 1 penny and 3 farthings. We therefore put down 3 farthings and carry 1 penny ; 1 penny and 6 pence and 11 pence and 2 pence and 9 pence and 7 pence are 36 pence = 3 shillings. We therefore put down 0 pence and carry 3 shillings.

3 shillings and 7 shillings and 10 shillings and 15 shillings and 4 shillings are 39 shillings = 1 pound and 19 shillings. We therefore put down 19 shillings and carry 1 pound.

1 pound and 1 pound and 6 pounds and 1 pound and 3 pounds are 12 pounds. We therefore put down 12 pounds, and our total is **£12 19s. 0¾d.**

Compound Subtraction

93. Compound subtraction is the method of finding the difference between two numbers of the same kind, but of different denominations.

Example :—

Subtract £29 18s 9½d. from £35 17s. 8¼d.

We shall proceed as we did in simple subtraction, i.e. we shall discover what must be added to £29 18s. 9½d. to make a total of £35 17s. 8¼d.

As before, we shall first write down our figures, as if we were adding.

£	s.	d.	
?	?	?	
29	18	9½	
£35	17	8¼	

We must add something to ½ for which we must write down ¼ in the total, i.e. the total must be 1¼d. This something must be ¾d. We therefore write down ¾ in our top line and go on with our addition : ½d. and ¾d. are 1¼d. ; carry 1d. ; 1d. and 9d. are 10d. ; 10d. and something must make a total ending in 8d. ; this total must be 20d. ∴ 20d. = 1s. 8d. ; therefore the something to be added must be 10d.

£	s.	d.	
?	?	10¾	
29	18	9½	
£35	17	8¼	

Put down 10d. and carry 1s., and proceed with the addition : 1s. and 18s. are 19s. ; 19s. and something added must make a total for which we must put down 17s., i.e. the total must be £1 17s., which = 37s. Hence the something to be added must be 18s. Put down 18s. and carry £1 ; £1 and £9 are £10. We must add something to £10 to make a total ending in £5 ; this something is £5 ; £5 and £10 are £15, and so on.

£	s.	d.	
5	18	10¾	
29	18	9½	
£35	17	8¼	

The result is now put down in the top line, but it is usual to write down the process more simply in one single step, as follows :—

£	s.	d.
35	17	$8\frac{1}{4}$
29	18	$9\frac{1}{2}$
5	**18**	**$10\frac{3}{4}$**

Exercise 32

Perform the following additions :—

(1) £	s.	d.	(2) £	s.	d.	(3) £	s.	d.
7	6	3	2984	7	$6\frac{1}{2}$	153	17	4
2	5	$4\frac{1}{4}$	104	15	$9\frac{3}{4}$	25	19	$2\frac{1}{2}$
204	13	$11\frac{1}{2}$	62	0	$1\frac{1}{4}$	14	2	$6\frac{3}{4}$
1	0	$6\frac{1}{4}$	0	13	$6\frac{1}{2}$	1001	10	0
15	19	$0\frac{1}{4}$	5	1	2	32	5	$10\frac{1}{2}$

(4) miles	fur.	po.	yd.	ft.	in.
32	4	35	3	1	10
104	1	0	5	2	6
0	7	22	1	0	7
500	6	31	4	1	9
2	3	1	1	2	5

(5) sq. m.	ac.	ro.	po.	yd.
439	281	1	29	6
20	561	0	15	27
51	265	3	0	5
0	10	0	16	20
107	615	2	39	28

Find the difference between :—

(6) £7 14s. 3d. and £5 19s. $7\frac{1}{2}$d. ; £59 15s. $4\frac{1}{4}$d. and £104 ; £100 16s. $9\frac{1}{2}$d. and £75 19s. $10\frac{3}{4}$d.

(7) 59 m. 7 fur. 21 po. 5 yd. 2 ft. 3 in. and 22 m. 4 fur. 6 po. 3 yd. 1 ft. 11 in.

Key to Exercise 26

(1) 2·25. (2) ·75. (3) ·625. (4) ·28. (5) ·0208. (6) 7·15576171875. (7) 2·985. (8) 2·96. (9) ·001. (10) 17·0017578125.

Key to Exercise 27

(1) $\cdot 1\dot{7}\dot{2}$, $\dot{5}$, $\cdot\dot{3}07692\dot{3}$, $\cdot\dot{1}42857\dot{1}$, $\cdot\dot{0}6976744186046511627\dot{9}$.

(2) $\cdot 4\dot{3}$, $\cdot 7\dot{1}\dot{3}$, $2\cdot 998\dot{3}76623\dot{3}$, $24\cdot 008\dot{4}97133\dot{3}$.

(3) $\frac{7}{9}$, $\frac{2}{45}$, $\frac{3}{110}$, $\frac{143}{100}$, $\frac{14}{1111}$, $\frac{9043}{16650}$.

(4) $\frac{3031809}{9999999}$, $\frac{2423}{16665}$, $\frac{581}{8999}$, $\frac{2399}{16500}$, $\frac{727}{5000}$.

(5) $\frac{7429}{1998000}$, $\frac{300721}{999999}$, $\frac{17507}{19998}$.

M. A. L.

ALGEBRA.—X

71. Fractions.

When the operation of division is represented by a horizontal line between the dividend and divisor the whole expression is called an algebraic fraction, the dividend is called the numerator, and the divisor is called the denominator.

We shall here deal only with fractions in which both numerator and denominator are rational integral functions of a variable or variables.

72. When we were dealing with the Laws of Association and Commutation for multiplication and division, we showed that $\frac{a}{b} = \frac{ma}{mb}$.

Hence we conclude, where a, b and m are rational integral functions of the variables x, y, z.... that the value of the fraction $\frac{a}{b}$ is not altered by multiplying both numerator and denominator by the same multiplier m.

And that the value of the fraction $\frac{ma}{mb}$ is not altered by dividing both numerator and denominator by the common factor m.

When we remove (by division) all common factors from numerator and denominator we are said to reduce a fraction to its lowest terms.

Thus $\frac{3a^2b^3c^4}{5ab^4c^2} = \frac{3ac^2}{5b}$

and $\frac{x^2-5x+6}{x^2+x-12} = \frac{(x-2)(x-3)}{(x-3)(x+4)} = \frac{x-2}{x-4}$

When we have to simplify or reduce to its lowest terms, a fraction in which the numerator and denominator have no obvious common factor, we find the H.C.F. of numerator and denominator.

Example :

Simplify $\frac{14x^5+7x^4+x^3-7x^2-5x-2}{21x^5+5x^3-6x^2-6x-4} = A$

H.C.F. of numerator and denominator $= 7x^3 - 3x - 2$

$A = \frac{(7x^3-3x-2)(2x^2+x+1)}{(7x^3-3x-2)(3x^2+2)} = \frac{2x^2+x+1}{3x^2+2}$

73. Multiplication and division of fractions. Again it follows from the Laws of Association and Commutation for multiplication and division that

$$\left(\frac{a}{b}\right) \times \left(\frac{c}{d}\right) \times \left(\frac{e}{f}\right) \times \left(\frac{g}{h}\right) \times \ldots = \frac{a.c.e.g.}{b.d.f.h.} \ldots$$

and that $\left(\frac{a}{b}\right) \div \left(\frac{c}{d}\right) = \frac{ad}{bc} = \left(\frac{a}{b}\right) \times \left(\frac{d}{c}\right)$

Hence, **the product of any two or more rational fractions is itself a rational fraction whose numerator is the continued product of all the numerators, and whose denominator is the continued product of all the denominators**

And,

the quotient of one rational fraction by another is itself a rational fraction whose numerator is the product of the numerator of the first fraction and the denominator of the second, and whose denominator is the product of the denominator of the first fraction and the numerator of the second

Or, in other words,

the quotient of one rational fraction by another is the product of the first fraction and the reciprocal* of the second.

Examples :—

$$\frac{(x^3-y^3)(x+y)}{(x^3+y^3)(x-y)}$$

$$= \frac{(x-y)(x^2+xy+y^2)(x+y)}{(x+y)(x^2-xy+y^2)(x-y)}$$

$$= \frac{x^2+xy+y^2}{x^2-xy+y^2}$$ (removing common factors from numerator and denominator)

* The reciprocal of $\frac{a}{b} = 1 \div \frac{a}{b} = 1 \times \frac{b}{a} = \frac{b}{a}$

74. Addition and Subtraction of Fractions.

Since $\frac{a}{b} = \frac{ma}{mb}$ it follows that any number of rational fractions may be transformed so as to have a Lowest Common Denominator.

If a, b, c, d, e, f be rational integral functions consider the algebraic sum $\frac{a}{b} - \frac{c}{d} + \frac{e}{f}$

Let D = the Lowest Common Multiple of b, d and f and let $\frac{D}{b} = \beta$, $\frac{D}{d} = \delta$ and $\frac{D}{f} = \varphi$ where β, δ, φ are rational integral functions.

Then $D = b\beta = d\delta = f\varphi$; and $\frac{a}{b}$

$= \frac{a\beta}{b\beta} = \frac{a\beta}{D}$; $\frac{c}{d} = \frac{c\delta}{d\delta} = \frac{c\delta}{D}$; and $\frac{e}{f}$

$= \frac{c\varphi}{f\varphi} = \frac{e\varphi}{D}$

$\therefore \frac{a}{b} - \frac{c}{d} + \frac{e}{f} = \frac{a\beta}{D} - \frac{c\delta}{D} + \frac{e\varphi}{D} = \frac{a\beta - c\delta + e\varphi}{D}$

If the functions b, d, f have no common factor $D = bdf$, and

$\frac{a}{b} - \frac{c}{d} + \frac{e}{f} = \frac{adf - bcf + bde}{bdf}$

Examples :—

(1) Simplify $\frac{1}{a+b} + \frac{1}{a-b}$

$\frac{1}{a+b} + \frac{1}{a-b} = \frac{(a-b)+(a+b)}{(a+b)(a-b)} = \frac{2a}{a^2-b^2}$

(2) Simplify $\frac{2x}{x+y} + \frac{2y}{x-y} + \frac{x^2+y^2}{x^2-y^2}$

$= \frac{2x(x-y)+2y(x+y)+x^2+y^2}{(x^2-y^2)} = \frac{3(x^2+y^2)}{x^2-y^2}$

(3) Simplify $\frac{1}{x-2} - \frac{2}{x-1} + \frac{2}{x+1} - \frac{1}{x+2}$

Here we shall save labour by grouping thus,

$\left\{\frac{1}{(x-2}} - \frac{1}{x+2}\right\} - \left\{\frac{2}{x-1} - \frac{2}{x+1}\right\}$.

$= \frac{(x+2)-(x-2)}{(x-2)(x+2)} - \frac{2(x+1)-2(x-1)}{(x-1)(x+1)}$

$= \frac{4}{x^2-4} - \frac{4}{x^2-1} = \frac{4(x^2-1)-4(x^2-4)}{(x^2-4)(x^2-1)}$

$= \frac{12}{(x^2-4)(x^2-1)}$

The student is warned to be very careful of his + and − signs.

(4) Simplify $\frac{1}{x+2} - \frac{3}{x+4} + \frac{3}{x+6} - \frac{1}{x+8}$.

Here again we group thus,

$\left\{\frac{1}{x+2} - \frac{1}{x+8}\right\} - 3\left\{\frac{1}{x+4} - \frac{1}{x+6}\right\}$

$= \frac{(x+8)-(x+2)}{(x+2)(x+8)} - 3\frac{(x+6)-(x+4)}{(x+4)(x+6)}$

$= \frac{6}{(x+2)(x+8)} - \frac{6}{(x+4)(x+6)}$

$= 6\left\{\frac{(x^2+10x+24)-(x^2+10x+16)}{(x+2)(x+4)(x+6)(x+8)}\right\}$

$= \frac{48}{(x+2)(x+4)(x+6)(x+8)}$

(5) Simplify

$$\frac{a^2\left(\frac{1}{b}-\frac{1}{c}\right)+b^2\left(\frac{1}{c}-\frac{1}{a}\right)+c^2\left(\frac{1}{a}-\frac{1}{b}\right)}{a\left(\frac{1}{b}-\frac{1}{c}\right)+b\left(\frac{1}{c}-\frac{1}{a}\right)+c\left(\frac{1}{a}-\frac{1}{b}\right)}$$

$$= \frac{\frac{a^2(c-b)}{bc}+\frac{b^2(a-c)}{ca}+\frac{c^2(b-a)}{ab}}{\frac{a(c-b)}{bc}+\frac{b(a-c)}{ca}+\frac{c(b-a)}{ab}}$$

$$= \frac{a^3(c-b)+b^3(a-c)+c^3(b-a)}{abc} \times \frac{abc}{a^2(c-b)+b^2(a-c)+c^2(b-a)}$$

Factorizing by the Remainder Theorem, we find this

$= \frac{(a+b+c)(c-b)(a-c)(b-a)abc}{(c-b)(a-c)(b-a)abc}$

$= a+b+c$

The student should note that it does not alter the value of a fraction to change all the signs in the numerator and denominator, for in so doing we multiply both by − 1

Thus $\frac{a}{b} = \frac{a\times(-1)}{b\times(-1)} = \frac{-a}{-b}$; and $-\frac{a}{b} = \frac{-a}{b}$

$= \frac{a}{-b}$; $\frac{b-c}{c-a} = \frac{c-b}{a-c}$

75. *Theorem.—If the fractions* $\frac{a_1}{b_1}, \frac{a_2}{b_2}, \frac{a_3}{b_3}\ldots$ *be all equal to each other, then each fraction will equal* $\frac{pa_1+qa_2+ra_3+\ldots\ldots}{pb_1+qb_2+rb_3+\ldots\ldots}$

Where $a_1, a_2, a_3\ldots b_1, b_2, b_3\ldots\ldots p, q, r\ldots\ldots$ are all rational integral functions.

Let $\frac{a_1}{b_1} = \frac{a_2}{b_2} = \frac{a_3}{b_3} = \ldots = \varphi$

$\because \frac{a_1}{b_1} = \varphi \quad \therefore a_1 = b_1\varphi$

similarly $\therefore pa_1 = pb_1\varphi$, $qa_2 = qb_2\varphi$, $ra_3 = rb_3\varphi$, ...

Hence by addition $pa_1 + qa_2 + ra_3$
$= pb_1\varphi + qb_2\varphi + rb_3\varphi + \ldots$
$= (pb_1 + qb_2 + rb_3 + \ldots)\varphi$

$\therefore \frac{pa_1+qa_2+ra_3+\ldots}{pb_1+qb_2+rb_3+\ldots} = \frac{(pb_1+qb_2+rb_3+\ldots)}{(pb_1+qb_2+rb_3+\ldots)}\varphi$

$= \varphi = \frac{a_1}{b_1} = \frac{a_2}{b_2} \ldots$

Theorem.—In the series of fractions $\frac{a_1}{b_1}, \frac{a_2}{b_2}, \frac{a_3}{b_3}\ldots$ *where* $a_1, a_2, a_3\ldots b_1, b_2, b_3\ldots$ *are rational integral functions, if all the denominators be positive, then will the fraction* $\frac{a_1+a_2+a_3+\ldots}{b_1+b_2+b_3+\ldots}$ *be greater than the least and less than the greatest of the fractions* $\frac{a_1}{b_1}, \frac{a_2}{b_2}, \frac{a_3}{b_3}\ldots$

Let $\frac{a_1}{b_1}$ be the greatest of the fractions, and let

$a_1 = \varphi$
b_1

then $a_1 = \varphi b_1$
$a_2 < \varphi b_2$
$a_3 < \varphi b_3$
....

Hence by addition $a_1 + a_2 + a_3 + \ldots < \varphi (b_1 + b_2 + b_3 + \ldots)$

$\therefore \frac{a_1 + a_2 + a_3 + \ldots}{b_1 + b_2 + b_3 + \ldots} < \varphi$

It may similarly be shown that

$$\frac{a_1 + a_2 + a_3 + \ldots}{b_1 + b_2 + b_3 + \ldots}$$

is greater than the least of the fractions.

Example :—

Show that if $\frac{a}{b} = \frac{c}{d}$, then will $\frac{a+b}{a-b} = \frac{c+d}{c-d}$

$\frac{a}{b} = \frac{c}{d} \therefore \frac{a}{b} + 1 = \frac{c}{d} + 1 \therefore \frac{a+b}{b} = \frac{c+d}{d}$ .. (i)

and $\frac{a}{b} - 1 = \frac{c}{d} - 1 \therefore \frac{a-b}{b} = \frac{c-d}{d}$ .. .. (ii)

$\therefore \frac{a+b}{b} \div \frac{a-b}{b} = \frac{c+d}{d} \div \frac{c-d}{d}$

$\therefore \frac{a+b}{a-b} = \frac{c+d}{c-d}$

Exercise 12

Simplify the following fractions :

(1) $\frac{49a^3b^2c^5d^9l^7m^6}{28a^5bc^7d^8l^5m^2}$. (2) $\frac{3a^3b^2cxy^2z^3}{6ab^3c^2x^3yz^2}$.

(3) $\frac{a^2 - 10ab + 16b^2}{a^2 - 4ab - 32b^2}$. (4) $\frac{(x^3 - y^3)(x^2 - y^2)}{(x^6 - y^6)(x^4 - y^4)}$.

(5) $\frac{x^3(y^2 - z^2) + y^3(z^2 - x^2) + z^3(x^2 - y^2)}{x^2(y^2 - z^2) + y^2(z^2 - x^2) + z^2(x^2 - y^2)}$.

(6) $\frac{1}{x+a} - \frac{4}{x+2a} + \frac{4}{x+3a} - \frac{1}{x+5a}$.

(7) $\frac{1}{2x^2 + 5x + 2} - \frac{2}{2x^2 + 3x - 2} - \frac{1}{2x^2 - 3x - 2}$.

(8) $x^2 \frac{(x+y)(x+z)}{(x-y)(x-z)} + y^2 \frac{(y+z)(y+x)}{(y-z)(y-x)} + z^2 \frac{(z+x)(z+y)}{(z-x)(z-y)}$.

(9) Show that $\left(a + \frac{1}{a}\right)^2 + \left(b + \frac{1}{b}\right)^2 + \left(ab + \frac{1}{ab}\right)^2 - \left(a + \frac{1}{a}\right)\left(b + \frac{1}{b}\right)\left(ab + \frac{1}{ab}\right) = 4$.

(10) Show that

$$\frac{p^4}{(p-r)(p-s)(p-t)} + \frac{r^4}{(r-s)(r-t)(r-p)} + \frac{s^4}{(s-t)(s-p)(s-r)} + \frac{t^4}{(t-p)(t-r)(t-s)} = p + r + s + t.$$

(11) Simplify—

$$\frac{\frac{1}{x} + \frac{2}{y}}{\frac{1}{x} - \frac{2}{y}} - \frac{\frac{1}{x} - \frac{2}{y}}{\frac{1}{x} + \frac{2}{y}}$$

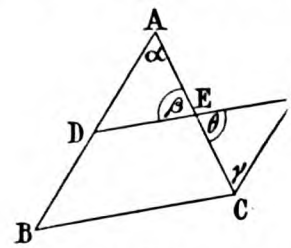
(*London Matriculation*, 1907).

M. A. L.

GEOMETRY.—IX

Proposition 45. Theorem

The straight line joining the middle points of two sides of a triangle is parallel to the third side, and is equal to one half of it.



Let A B C be a △ and D E the str. line joining the middle pts. D and E of A B, A C respectively.

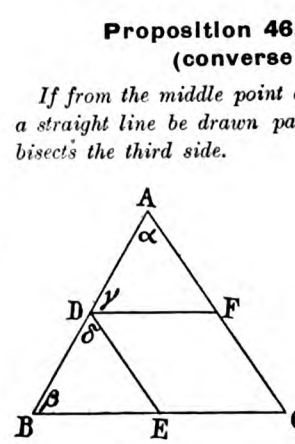
It is required to prove that—

(1) D E is ‖ to B C.
(2) D E = ½ B C.

Proof.—Produce D E to F, making E F = E D.
Join F C.
In △s A E D, C E F.
A E = C E (hypothesis).
E D = E F (construction)
included ∠ β = included ∠ θ (vertically opp., Prop. 3).
∴ △ A E D ≡ △ C E F (Prop. 5)
∴ F C = A D = D B,
and γ = α,
but γ and α are alt. ∠s ∴ F C is ‖ to A B (Prop. 23).
Hence F C and D B are equal and ‖ str. lines.
∴ D F and B C are equal and ‖ str. lines (Prop. 30),
but D E = ½ D F.
∴ D E = ½ B C.

Proposition 46. Theorem (converse of 45)

If from the middle point of one side of a triangle a straight line be drawn parallel to another side, it bisects the third side.



Let A B C be a △. and from the middle point D of A B, let D E, D F be drawn ‖ to A C, B C respectively, cutting B C and A C at E and F.

It is required to prove that B C is bisected at E and A C at F.

Proof.—In △s A D F, D B E
α = corresponding ∠ δ (D E is ‖ to A C) (Prop. 26).
γ = corresponding ∠ β (D F is ‖ to B C) (Prop. 26).
A D = D B (hypothesis)
∴ △ A D F ≡ △ D B E (Prop. 9).
∴ D F = B E.
But D F = E C (D F C E is a □) (Prop. 31),
i.e. B C is bisected at E.
Similarly A C is bisected at F.

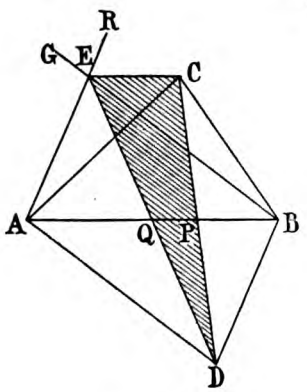
Proposition 47. Theorem

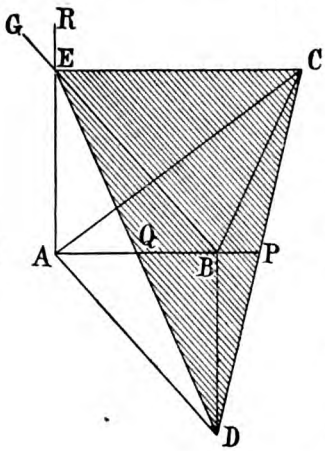
If two triangles of equal area have the same base and lie on opposite sides of it, the line joining their vertices is bisected by the common base.

Let A B C, A B D be △s of equal area on opp. sides of base A B. Let C D cut A B (or A B produced) at P.

It is required to prove that C P = D P.

Proof.—Draw A R ‖ to B D and B G ‖ to A D, and let them cut at E. Join E C and E D, cutting A B at Q.





A E B D is a ▱.
∴ A B bisects it (Prop. 31).
∴ △ A E B = △ A D B.
∴ △ A E B = △ A C B.
∴ E C is ‖ to A B (Prop. 35, Cor. 4).
Now Q is middle pt. of A B (diags. of a ▱ bisect each other—Prop. 31, Cor. 1).
And Q P is ‖ to E C.
∴ Q P bisects the side C D of △ D E C (Prop. 46), i.e. P is then middle pt. of C D,
i.e. A B bisects C D at P.

Definition.—The straight line joining an angular point of a triangle to the middle point of the opposite side is called a **median.**

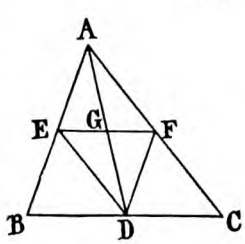
Proposition 48. Theorem

If a line be drawn parallel to a side of a triangle, the part of it which lies between the other sides is bisected by the corresponding median

Let A B C be a △, let E F be ‖ to B C, and let the median A D cut E F at G.

It is required to prove that G E = G F.

Proof.—Join E D, F D.



△ B D A = △ C D A
△ B D E = △ C D F
(equal bases and same altitude—Prop. 35, Cor. 3).

∴ by subtraction △ D E A = △ D F A, but these are on opp. sides of base A D.
∴ E F is bisected at G by A D (Prop. 47).

Definition.—Lines which meet in a point are said to be **concurrent.**

Proposition 49. Theorem

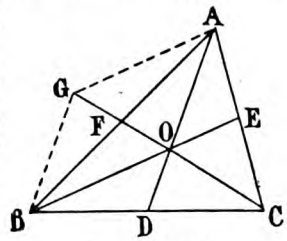
The medians of a triangle are concurrent.

Let A B C be a △, and let the medians A D, B E cut at O.

Join C O and produce C O to cut A B at F.

It is required to prove that C F is a median of the △ A B C.

Proof.—Produce C F to G, making O G = O C.
Join B G, A G.
O D is ‖ to G B (O and D are middle pts. of C G and C B in △ C G B—Prop. 45), i.e. A D is ‖ to G B.



Similarly B E is ‖ to G A.
∴ G A O B is a ▱.
∴ the diags. bisect one another (Prop. 31).
∴ F is the middle pt. of A B.
∴ C F is a median of △ A B C,
i.e. the medians of the △ are concurrent.

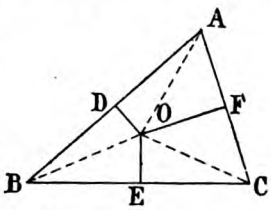
Proposition 50. Theorem

The straight lines drawn at right angles to the sides of a triangle at their middle points are concurrent.

Let A B C be a △. Let D E F be the middle pts. of A B, B C, C A respectively.

Let the ⊥ to A B at D and the ⊥ to A C at F meet at O.

Join O E.



It is required to prove that O E is ⊥ to B C.

Proof.—Join O A, O B, O C.
In △s A O F, C O F
A F = C F (hypothesis).
O F is common,
included ∠ A F O = included ∠ C F O (hypothesis) (Prop. 5).
∴ △ A O F ≡ △ C O F.
∴ O A = O C.
Similarly O A = O B.
∴ O B = O C.
In △s O E B, O E C,
(i.) O B = O C. (ii.) B E = C E (hypothesis). (iii.) O E is common.
∴ △ O E B ≡ △ O E C (Prop. 8).
∴ ∠ O E B = ∠ O E C.
∴ each is a rt. ∠,
i.e. O E is ⊥ to B C,
i.e. the ⊥s to the sides at D, E, and F are concurrent.

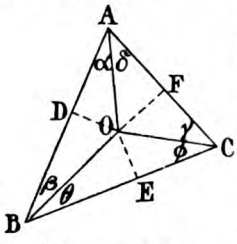
Proposition 51. Theorem

The lines bisecting the angles of a triangle are concurrent.

Let A B C be a △ and let the bisectors of the ∠s at A B C and A C B meet at O.

Join O A.

It is required to prove that O A bisects ∠ B A C, i.e. that $\alpha = \delta$.



Proof.—From O draw O D, O E, O F ⊥ to A B, B C, C A respectively (Prop. 22).

In △s O D B, O E B,

∠ O D B = ∠ O E B (both rt. ∠s).

$\beta = \theta$ (hypothesis).

O B is common.

∴ △ O D B ≡ △ O E B (Prop. 9).

∴ O D = O E.

Similarly O F = O E.

∴ O D = O F.

In △s A O D, A O F,

∠s at D and F are rt. ∠s,

hypotenuse A O is common,

O D = O F.

∴ △ A O D ≡ △ A O F

∴ $\alpha = \delta$,

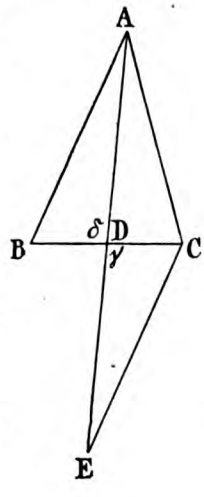
i.e. O A bisects ∠ B A C,

i.e. the lines bisecting the ∠s of the △ are concurrent.

Proposition 52. Theorem

Any two sides of a triangle are together greater than twice the median through the angular point where they meet.

Let A B C be a △ and let A D be the median through A.



It is required to prove that A B + A C > 2 A D.

Proof.—Produce A D to E, making D E = D A.

Join C E.

In △s A D B, E D C,

A D = D E (construction).

B D = C D (hypothesis),

included ∠ = included ∠ (vertically opp. ∠s—Prop. 3).

∴ △ A D B ≡ △ E D C (Prop. 5).

∴ A B = C E.

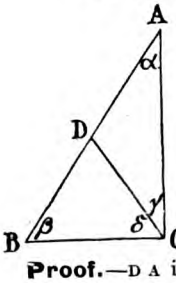
In △ A C E,

A C + C E > A E (Prop. 12),

i.e. A C + C E > 2 A D.

∴ A C + A B > 2 A D.

Proposition 53. Theorem



The middle point of the hypotenuse of a right-angled triangle is equidistant from all three angular points.

Let D be the middle pt. of the hypotenuse of the rt. ∠ △ A B C.

It is required to prove that D A = D B = D C.

Proof.—D A is given = D B.

Either (1) D C < D A and ∴ < D B.

(2) D C > D A and ∴ > D B.

(3) D C = D A = D B.

Now $\delta + \gamma$ = 1 rt. ∠.

$\alpha + \beta + \delta + \gamma$ = 2 rt. ∠s.

∴ $\alpha + \beta$ = 1 rt. ∠.

∴ $\alpha + \beta = \gamma + \delta$.

(1) If D C < D A and < D B

∵ D C < D A ∴ $\alpha < \gamma$

∵ D C < D B ∴ $\beta < \delta$ (Prop. 10).

∴ $\alpha + \beta < \gamma + \delta$;

but $\alpha + \beta = \gamma + \delta$ ∴ (1) cannot be true.

(2) If D C > D A and > D B

∵ D C > D A ∴ $\alpha > \gamma$

∵ D C > D B ∴ $\beta > \delta$ (Prop. 10).

∴ $\alpha + \beta > \gamma + \delta$,

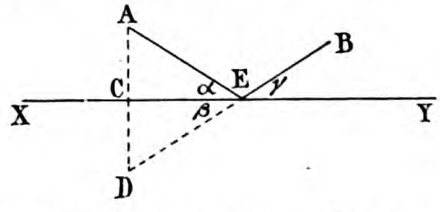
but $\alpha + \beta = \gamma + \delta$ ∴ (2) cannot be true.

∴ (3) must be true,

i.e. D C = D A = D B.

Proposition 54. Problem

From two given points on the same side of a given straight line, draw two straight lines meeting in the given line, and making equal angles with it.



Let X Y be the given str. line and A B the given pts. on the same side of it.

From A draw A C ⊥ to X Y (Prop. 22).

Produce A C to D, making C D = C A.

Join D B, cutting X Y at E.

Join A E.

A E, B E are the lines required.

Proof.—In △s A E C, D E C,

A C = D C (construction).

C E is common.

∠ A C E = ∠ D C E (rt. ∠s).

∴ △ A E C ≡ △ D E C (Prop. 5).

∴ $\alpha = \beta$,

but $\beta = \gamma$ (vertically opp. ∠s) (Prop. 3).

∴ $\alpha = \gamma$.

i.e. A E, B E meet in X Y and make equal ∠s α and γ with X Y.

Exercise 11

1. Construct a quadrilateral A B C D, ∠ at A = 50°, ∠ at B = 110°; A B = 2 in., A D = 1·75 in., B C = 1·25 in.; measure the other angles; reduce the quadrilateral to a triangle of equal area, and calculate the area.

2. Construct a parallelogram having one side 6·5 cm. long, one angle = 70°, and one diagonal 8·5 cm. long.

3. The bisectors of the interior angles at B and C of a triangle A B C meet the bisector of the exterior angle at A in the points P and Q respectively, and B P, C Q meet at O. Prove that ∠ O P Q = ∠ A C O, and ∠ O Q P = ∠ A B O.

M. A. L.

Continued from Vol. I., page 504.

ART AND MUSIC:

Contributors:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).

DRAWING.—VII

Up to the present you will have confined yourself to outline, the drawing of objects, having regard only to their angles, their perspective, in fact their skeletons. It may as well be repeated here (and it cannot be repeated too often), that the student should go on practising this outline work until he is really master of it. It is not the slightest use going ahead to the intricacies of detail, or the more interesting and absorbing methods of shading, until the groundwork is complete.

Tone Values

Shadows are exceedingly important. Indeed, all branches of drawing are important, but they all depend for their usefulness and their effect upon each other. Good outline may well be spoiled by poor shading, but first rate shading would mean little or nothing if it is based on an incorrect outline. So, really, outline is the most important of all. Besides, if you can draw an outline correctly, that in itself is a good and useful drawing. It may easily be, moreover, a beautiful drawing—which is most important, and your primary object, as a rule, in drawing at all. But of what use can shadow possibly be without the skeleton on which it is built?

The student has then occupied himself hitherto with the question of *form;* he must now turn to the question of *values*, which is to say the strength or intensity of tone.

As before, a beginning can well be made by a careful study of any object in the room, or part of it. There is a table by the wall. Here, you notice, it is quite dark, here again it is less dark—a middle tint, in fact, and there it is quite light. The value of tones is easily observed like this. Notice the object broadly, not scrutinising it for detail, but roughly taking in the shape, size and variation of the shadows. You can do this well with your eyes half closed. Shadows are classified in the following way: there are decided shadows, and these are sometimes called positive, and there are also half tints.

These are subdivided again. Positive shadows are broad or cast. These words require explanation. Broad shadows are those which lie upon any given object. Cast shadows are those which are cast or thrown by the object you are dealing with on to the ground or floor, or one or more other objects.

Fig. 30 illustrates this: *a* represents the broad and *b* the cast shadow. Sometimes the broad shadow is equal in tone to the cast shadow. But more often the cast shadow is darker. The reason is that a cast shadow usually lies on the ground, which will generally be a large surface. All round the surface covered by the shadow is a mass of other surface to which the light penetrates. The rays of light are refracted upon the broad shadow, which necessarily lowers the tone of that shadow and makes it less dark. Turn again to Fig. 30: the arrow indicates the direction from which the light falls on the object. Wherever the object comes between the stream of light and the ground, there must be shadow—that is, at least partial darkness. Rays of light on the ground at *g g* are refracted or hurled back with diminished power to *a*. This makes the broad shadow *a* less intense and paler than the cast shadow *b; b* is on the same surface, in fact is part of the same surface as *g g;* so that it is impossible for any rays of light on that same surface to affect it.

Two Methods of Shading

There are two outstanding methods of rendering a flat tone in ordinary elementary drawing. The first of these is the drawing of straight parallel lines close to each other. (The closer they are the darker the shadow, of course.) The second method is known by the name of cross-hatching, which is simply the first method repeated at right angles, so that the lines are crossed. We will deal with these methods in their order. First, when there is a big space to be filled up with shadow, use perpendicular lines of unequal length. You should be specially careful not to let the ends of these lines intrude

on each other. If, however, your space is small, you can fill it up with continuous lines. In the first place, to put it more plainly, you can make several little lines end to end, in the latter one line can be accurately and easily drawn. Then the process can be repeated again and again on a parallel until the space to be shaded has been completely covered. Be careful, of course, to put a regular pressure on the pencil, so that your lines are of equal thickness. Fig. 29 suggests a useful exercise which the student will be well advised to practise now and again.

Fig. 30 explains the continuous lines already referred to. It is scarcely necessary to add here that the line method is not the only one for shading. Chalk or powdered lead is used, rubbed on evenly with an instrument specially made for that purpose called a "stump." That is generally a thickish roll of paper coming to a hard-pointed end which distributes the chalk over the necessary surface and gives a particularly soft and pleasing effect.

The beginner will do better to stick to the plain line.

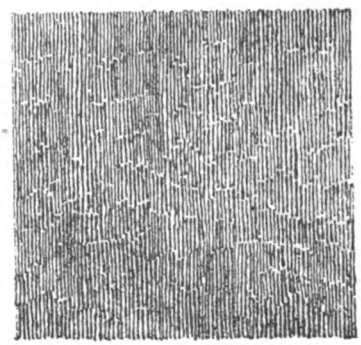


Fig. 29.—A useful shading exercise. Lines of equal thickness can be ensured only by a regular pressure of the pencil.

In copying Fig. 32, observe that the cast shadow of the wall is made of lines on the horizontal surface of the steps, which are drawn towards the vanishing point of those steps. You must now closely follow the rule which gives the accurate edge of the shadow. Take Fig. 31. In this A is the wall which throws a shadow on the steps, *a b*, *c d* and *e f* are dotted lines from the top of the wall to the surface of the steps. They represent the inclination of the rays of the sun. The end of the wall rises vertically from the end of the step at *k*, so that the shadow of the top of the wall at *a* will be at *b*, and the shadow of the edge *a c* will be at *b g*; *b g* is a line which has the same vanishing point as *c a*, which is the upper edge of the wall. The edge of the shadow on the front or face of the steps is the inclination of the rays of light, and the edge of shadow on the top surface or tread of the steps is directed towards the Point of Sight. The upper edge or top of the wall casts a shadow whose edge comes to the irregular line or series of lines *b g*, *d h*, *f i*, *m n*.

Once having grasped the principle of this, set out to practise it in a variety of different drawings; making sure before you begin what extent the shadows have, and what the depths of their tints are. Do not, on any account, content yourself with copying figures represented here. If you do that, you will fall into the temptation of acquiring a mere parrot-knowledge. You may be able to copy accurately, but you will, most emphatically, *not* be able to apply the given rules to original work. You need to understand the rules and to apply them to any object you care to set yourself. Any chair or table, or room or house should be drawn with the right shading, just as it should be drawn with the right perspective, once you have thoroughly grasped the governing principle.

In copying, it should be noted well that not only must you get the thickness of individual lines accurately, so that the tone of the whole shadow is right, but you must make each line firmly and without hesitation. This is as highly important in copying a simple drawing as in drawing from some object of your own choice. Observe, too, that lines in different parts of the shading run in different directions. Why is this? Simply to show the difference between various materials. In a plain, uncoloured

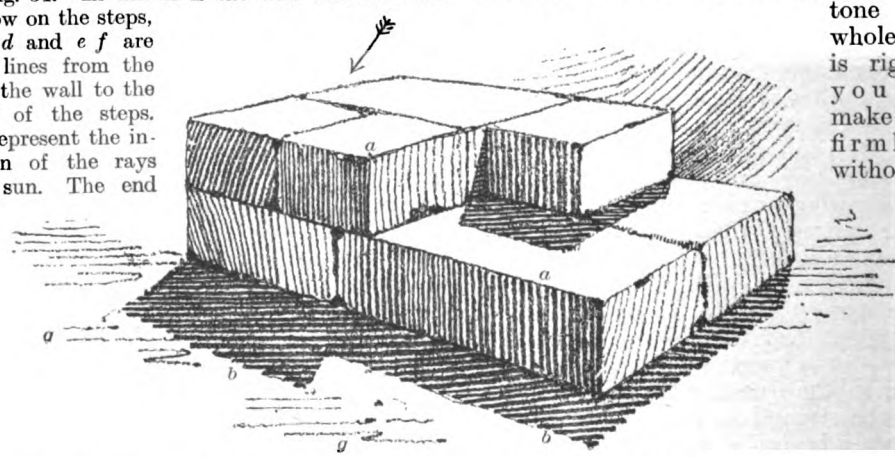


Fig. 30.—A simple study in *broad* and *cast* shadows. Broad shadows are those which lie on a given object; cast shadows are those thrown by that object on the ground.

drawing, you must find some means of showing that brick is brick and that wood is wood; or, at all events, of showing that the various materials in an object *are* different. The outline will help you to a certain extent, but not sufficiently.

Before continuing the technical rules which govern shading, it is as well to make a few general remarks on the uses of shadows. It has been said before that outlines can give a representation of a given object. But it should be borne in mind that objects do not really appear as outlines, save, perhaps, when a dark building stands in silhouette against the sky. The true appearance of any object is made up of light and shade in various degrees of strength or intensity. In drawing, we make the outline in order to get the position of the patches of light and shade right; in order to measure distances, and so on. In this way the outline is most truly and literally the skeleton.

The beginner or one who knows practically nothing about drawing will, when asked to draw any particular object, give the outline only. He does this not because it looks like that to him, but because he *knows* that the outline is something of the kind. He acts upon knowledge outside of what he sees at the moment. He *sees* a house and it *appears* to him made up of various masses of light and shade. But he disregards this appearance. He knows, as it happens, that the top of the roof is one line broken by other lines which form a chimney, and so on throughout. Knowledge (in that sense) is only a useful accessory to drawing.

This is not said in any disrespect of outline, which, as already described, can be exceedingly beautiful. So far we have dealt only with the appearance of shadows, and have spoken only of their uses as part of a drawing from the purely artistic point of view. But it is also necessary to demonstrate their value in describing an object.

Draw a circle on a piece of paper and it conveys to you nothing but a circle—a flat surface. The addition of detail would make it—say a coin, and yet a circle is the outline of a variety of objects far more complex than any coin and, if only viewed from different points, utterly unlike a coin. A circle may, for instance, be the outline of a basin, or it may be the outline of a ball. What two objects could be so entirely dissimilar? This outline will only serve the basin, of course, when regarded immediately from above. A ball, on the other hand, has a circular outline whichever way you look at

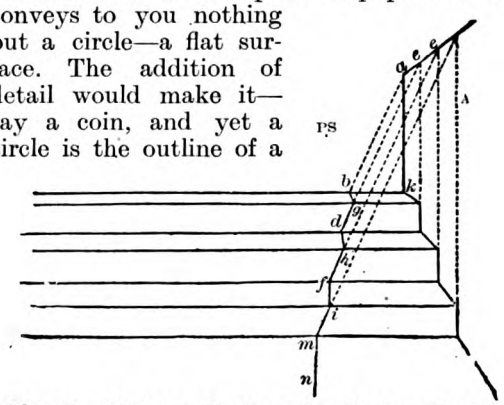


Fig. 31.—Skeleton Outline of a Shadow Study (*See below*).

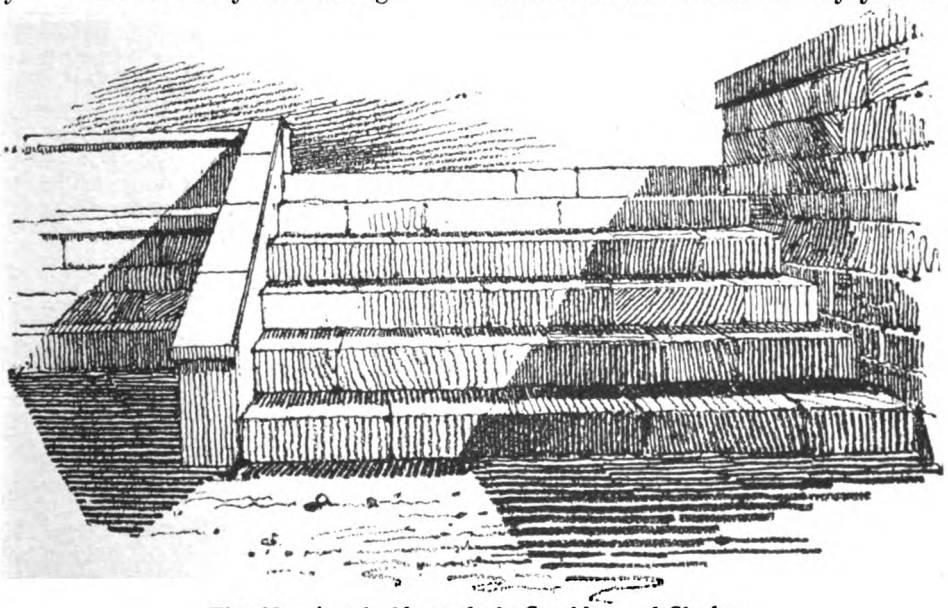


Fig. 32.—A valuable study in Sunshine and Shadow.

it. A ball is a sphere, a basin viewed from above is a concave. The difference between these things can only be shown by shading.

Correct shading gives the *form* or shape of the object. There is no line to help you in this simple instance quoted. Your only means of differentiation is by shadow. If you shade a circle in one way you can see that it is concave—a hollow shape. You can give a perfectly exact and unmistakable representation — though in so simple an instance it is peculiarly difficult to do so. You shade a circle in another way and you see that the object is spherical; geometrically speaking, solid. You recognise it as a ball. Given a little touch of irregularity in outline and a certain variety in the method of shading, and the object becomes an orange. All these things and others are represented from at least one aspect by a perfectly plain circle.

Form and Shape

A few simple experiments will teach you a great deal about the various qualities of shadows and the way they act. Take, for instance, a tennis ball and lay it on your drawing board—the board to be lying flat on a table, of course. So arrange your table that the light falls from left to right. Roughly speaking the ball will now be divided into two parts—light and shade. Then you will see that on the right-hand side of the ball there is a space of darkness varying from considerable density towards the light on the board itself. This is the shadow cast by the ball; that is to say, the body of the ball—an opaque substance—prevents the light from falling upon that part of the drawing-board. The length of the shadow depends, of course, upon the inclination of the light rays from the sun. If the sun is very low the shadows are very long; as, of course, you know from watching your own lengthening shadow on the grass or along a road.

Some authorities make a distinction by calling cast shadows merely *shadows* and any part of a surface turned away from the direct light as *shades*. The surface upon which a shadow is cast makes a good deal of difference to its density. Thus, if you have brown paper beneath the ball on your board you get a dense shadow; if the paper is white, much more light is reflected, and therefore the shadow is in parts much lighter than in the former case. The brightest point opposite the light on a given object is known as the *high-light*. The rest is in half-tone. J. G. B. L.

THE PEACOCK ROOM

One of the most famous achievements of James McNeill Whistler was the renowned Peacock Room. This was in the house of Mr. Frederick R. Leyland in Prince's Gate, and the memory of it will remain for all time quite unique in the history of decoration.

Mr. Leyland, who had a fine set of pre-Raphaelite pictures, comprising a set of pictures by Burne-Jones, Ford Madox Brown, and Rossetti, also possessed Whistler's "La Princesse du Pays de Porcelaine." This was in his dining-room, over the mantel. This room was done in walnut wood with panels of Spanish leather, and innumerable shelves for Mr. Leyland's collection of Oriental china.

Whistler saw at once that the colour of this leather did not harmonise with his picture. It was of too dark a tone; and Whistler tried to lighten it by touching it here and there with a brushful of yellow. This expedient, however, had not the desired effect. And after some deliberation the decoration which has given the name to the room was planned and carried out by Whistler himself.

Peacocks everywhere—that was the keynote of the scheme. The full-length painting of the bird—two of them in some cases upon doors or bare spaces of wall, with wonderful spreading tails, amazing shimmering blues and lavish gilding. The ceiling was a mass of peacock's feathers—the exquisite "eye" appearing everywhere, repeated again and again in every conceivable variation.

Whistler's Achievement

In order to reach the tops of the walls, Whistler had to stand upon a scaffolding; and he lay in a hammock whilst he did the ceiling. In some cases where breadth of effect was required no more urgently than ease of access, he used a brush tied to the end of a fishing-rod. This remarkable work took about six months to perform in the two years 1876 and 1877.

It should be remembered that all his elaborate undertaking was carried out simply to provide a suitable environment to Whistler's picture "La Princesse du Pays de Porcelaine," which had been completed more than ten years before this. So exact was Whistler, and so eager to be true to his own ideals, that he actually had a red border cut from a beautiful Eastern carpet, because the red there was prone to detract from the touches of the same colour in his own picture. J. G. B. L.

After the painting by J. M. Whistler.

LA PRINCESSE DU PAYS DE LA PORCELAINE.

The artist himself specially designed the famous Peacock Room in Mr. Frederick R. Leyland's house at Prince's Gate, London, as a fitting setting for this beautiful picture.

Continued from page 56.

BUSINESS AND COMMERCE

***Contributors*:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).**

CHOOSING A CAREER.—X

THOUGH everyone earning a living in the employ of the Government is a Civil Servant, the Civil Service in a conventional way may be said to embrace the varying grades of appointments for clerical work in the innumerable offices and departments through which the business of the State passes.

The Civil Service

To review the openings of the Service is no light task, particularly in view of a scheme of drastic reconstruction that has come about. Practically speaking, though, the Civil Service may be divided into two main classes of employment: 1, those grades recruited by nomination and influence; and 2, those filled as the result of open, competitive examination. The latter class is by far the greater, and the tests for the appointment of candidates are conducted almost exclusively by the *Civil Service Commission, Burlington Gardens, London, W.*1, a department of the Government devoted to the selection of persons to fill such vacancies as may from time to time occur.

Intending candidates must bear in mind that the Civil Service Commission is not concerned with the fixing of salaries, and that its duties begin and end with the conducting of examinations and approving of candidates. Information could not be given to candidates as to the details of examinations, methods of conducting them and similar matters; but on many points of general interest and guidance letters of inquiry would be answered, and would-be Civil Servants cannot be too particular in going as deeply as possible into every aspect of the service before devoting their time and resources to preparing for an examination.

We mention this matter because a good deal of misconception exists in the matter of Civil Service appointments and how to obtain them.

Strictly speaking, it is highly advisable that the would-be candidate should actually receive lessons and coaching from a reliable tutor, from a special class at his school, or at a recognised college where students are prepared for Civil Service examinations. Such educational facilities are offered in almost every town, and the young man or young woman earnestly wishing for appointment would be ill-advised not to profit by these specialised classes in which particular stress is laid upon the subjects of the examination.

The question of physical fitness, again, requires special consideration. It must be remembered that the Commissioners conduct their examinations, select the candidates for vacancies, and then make inquiries as to suitability in other directions. In other words, the matter of physical qualification is not gone into until *after* the educational test.

Medical Examination

In cases, therefore, where there are grounds for doubt, the candidate should be first examined by his or her own medical attendant. The chief point to bear in mind is not only that the candidate shall be fit and well at the moment, but that there shall be no physical defect likely to interfere with continuous effective service in the future; thus, there may be no actual disease and yet a weakly constitution that would debar the applicant. With some appointments, notably those of the Post Office, there are regulations as to height and weight, and these should be carefully considered beforehand.

Deafness would of course prove a bar, and so would defective eyesight, though there are cases where glasses have to be worn that might still be accepted for appointment. In some instances colour-blindness is a bar, and teeth are often considered,

whilst bad stammering might lead to the rejection of a candidate. All applicants are also advised officially *before competing* to ascertain that they are free from *albuminuria.*

It goes without saying that the applicant for a Civil Service appointment must be a natural-born British subject, and the child of natural-born British subjects, and for appointment in the Foreign Office, and in some of our overseas Dependencies, there are birth and nationality restrictions that should not be overlooked.

Notice of the open competitive examinations is given by advertisement in some of the chief London and provincial newspapers. In the case of the London papers, the advertisements usually appear on Thursdays. Until an examination is officially announced, the Civil Service Commission cannot record the names of intending candidates, but copies of the regulations of the examinations will be supplied on application to the Secretary of the Commission. It is interesting to note as well that many booklets and pamphlets of the utmost interest to intending candidates (including past examination papers) are published, and may be obtained from *H.M. Stationery Office, Imperial House, Kingsway, London, W.C.*2, usually at very small cost, including postage.

Examination Fees

There are fees to be paid by candidates in advance of the examinations ranging from one shilling to £6. Where the initial salary does not exceed £50 a year, the fee is 1s.; up to £75 a year, 2s. 6d.; under £100, 5s., and so on. With salaries between £500 and £600, the fee is £5, and over £600, £6.

In a general sense the Civil Service is so divided as to provide openings for all classes. There are appointments to be obtained practically only by public school and university men; there are lower grades for those with a secondary school education. In the reconstruction plans wider scope is given and also certain privileges for those who have been engaged temporarily in the Government service or who have served in Navy, Army or Air Force.

To begin at the top of the list, the first large section is that of CLERKSHIPS, Class I., which forms the upper division of the Service. Candidates who would seek such appointments should remain at a public school until they are at least eighteen years of age, and then complete their education at a university. Certainly, the great majority of successful candidates come from the universities.

A successful candidate for a Clerkship, Class I., may be appointed to the Treasury, Home Office, Colonial Office, Inland Revenue, War Office, Admiralty, India Office, Board of Trade, and in other departments, and such clerks may rise to hold high State appointments. The regulations pertaining to this class vary from time to time, but may always be obtained by writing to the Secretary, Civil Service Commission.

Class I. is followed by a kind of Intermediate Class, designed to absorb men of public school education who have not been able to proceed to a university. Usually candidates are called upon to satisfy the Commissioners that they have received whole-time continuous and systematic education at least until the age of 18.

The Selection Board

Selected candidates are then eligible to undergo a qualifying examination, upon the results of which they are summoned to an interview by a Selection Board. In this case, however, as with Class I., intending applicants are advised to write to the Civil Service Commission for copies of the latest regulations in force, mainly because this Intermediate Class in the Home Civil Service is open only to ex-Navy, Army or Air Force men, and those who have served temporarily in Government offices.

The following groups of situations are filled by successful candidates in the Intermediate Class:

Junior Appointments in the Supply, Accounting and Transport Departments of the Admiralty.

Class III. Clerkships under Crown Agents for the Colonies.

Junior Clerkships under the Ecclesiastical Commission.

Examinerships in the Exchequer and Audit Department.

Assistant Surveyorships of Taxes; Second-class Clerkships in the Estate Duty Offices, London, Edinburgh, and Dublin, all in the Inland Revenue Department.

Clerkships under the Metropolitan Police.

Clerkships, Examinerships and Assistant-inspectorships under the National Health Insurance Commission.

Second-class Clerkships under the National Health Insurance Commission (Scotland).

Other appointments under the National Insurance Dept.

A. C. M.

BOOK-KEEPING.—VII

General Résumé of the Ground Already Covered, with some Notes on Banks and Banking.

ALTHOUGH Book-keeping is not a subject which depends wholly on the memory, it is one which calls for a thorough knowledge of principles and their application. The student is therefore recommended to revise from time to time the portions of the subject already studied. In order that he may do this the more effectively, a brief summary of the points already explained is given below, and, with a view to facilitating reference, each lesson is treated separately.

Lesson I (Vol. I., *p.* 61)

It is only by becoming familiar with the underlying principles governing the subject that practical work can be done intelligently. The object of account keeping is to enable a man to know at any time the state of his affairs from a monetary point of view, and also his financial relationships to others.

Double entry is the only system by which the desired results can be attained. It is so called because the double effect of every business transaction finds a record in the books.

The leading principle of double entry is that every debit has its corresponding credit; two accounts being necessarily affected by every transaction.

The Journal as explained in this lesson is used merely for the purpose of elucidating the real meaning of debit and credit, and impressing this firmly upon the student's mind.

Debits are placed on the left, and credits on the right according to the following rules:

Debit losses and credit gains.

Debit what comes in, and credit what goes out.

Debit the person with what he receives, and credit him with what he gives.

Lesson II (Vol. I., *p.* 125)

The Ledger is the most important of the books of account, and it is the only one by the use of which a man may know the true position of his affairs.

Records in the Ledger are called "Accounts."

When posting the Accounts from the Journal to the Ledger, debits are debited, and credits are credited.

The Trial Balance is a summary of Ledger balances in the form of debits and credits. As every debit has its corresponding credit, the totals of the two sides should be equal.

Lesson III (Vol. I., *p.* 188)

Ledger Accounts are closed by adding to the smaller side such a sum as will make the two sides equal. This difference is then brought down on the side which was originally the heavier. The amount brought down is referred to as the Balance of the Account, and is called a debtor balance if on the debit side, and a credit balance if on the credit side.

The Purchases Book is the book in which credit purchases are recorded. Sometimes these are entered with full details, at other times with totals and names only, invoices being preserved for reference purposes. The Personal Accounts of the sellers are credited with the various items, and the Purchases Account in the Ledger is debited with the total.

Lesson IV (Vol. I., *p.* 254)

The Sales Book, as the name implies, is the one in which credit sales are recorded. In principle it is the same as the Purchases Book, and is kept in a similar manner. The Personal Accounts of the various purchasers are debited with the value of the goods sold to them, and the Sales Account in the Ledger is credited with the total.

Returns Books contain records of goods returned either to or from a person. When goods which have been sold are returned to the seller, they are referred to in his books as Returns Inwards, and are entered in the Sales Returns Book. The Sales Account is debited, and the Account of the person returning the goods is credited. Goods bought and afterwards returned are entered in the Buyer's Returns Outwards or Purchases Returns Book. They are posted to the credit of the Purchases Account, and the Account of the person to whom the goods are returned is debited.

The Cash Book is the book in which records of cash are entered, the receipts being debited, and the payments credited. The person from whom, or the purpose for which, cash is received is credited, whilst the person to whom, or purpose for which, cash is paid is debited. The Cash Book may be regarded as a Ledger Account kept in a separate book for convenience. It should be remembered that the balance of the Cash Book must be included in the Trial Balance.

Lesson V (*Vol. I., p.* 381)

Assets are property of any description, including cash, goods, premises, book-debts, etc.

Liabilities are debts or monetary obligations.

Assets and liabilities, when recorded at the opening of the books, are passed through the Journal. Assets are debits, and liabilities are credits. When the assets are the greater the difference represents Capital, whilst when the liabilities are the greater the difference represents a deficiency.

The Trading Account is an Account by means of which the gross profit or loss is ascertained. It is debited with the stock at the beginning, with purchases and purchase and manufacturing expenses, such as wages and carriage inwards. On the credit side are entered the sales and the stock at the end of the trading period. The balance of this account representing gross profit is transferred to the Profit and Loss Account, to which also other expenses of the business are transferred. The balance of this account represents the net profit or loss. The Profit and Loss Account is closed by having the balance transferred to the Capital Account.

The Balance Sheet is a statement of the assets and liabilities of a business. It is made up of the balances of the various accounts from the Ledger, Cash Book, etc. The assets are placed on the credit side, and the liabilities on the debit side. As the Capital is included on the debit side, the debits and credits must necessarily be equal.

Lesson VI (*Vol. I., p.* 508)

Interest is the sum or rate agreed to be paid by the borrower of money to the lender for its use. When charged against the debtor Interest Account is credited, and the debtor's personal account is debited. In the books of the debtor the entries will be reversed, that is to say, his Interest Account will be debited, and the creditor's personal account credited. When Interest is charged on Capital the Interest Account is debited, and the Capital Account credited.

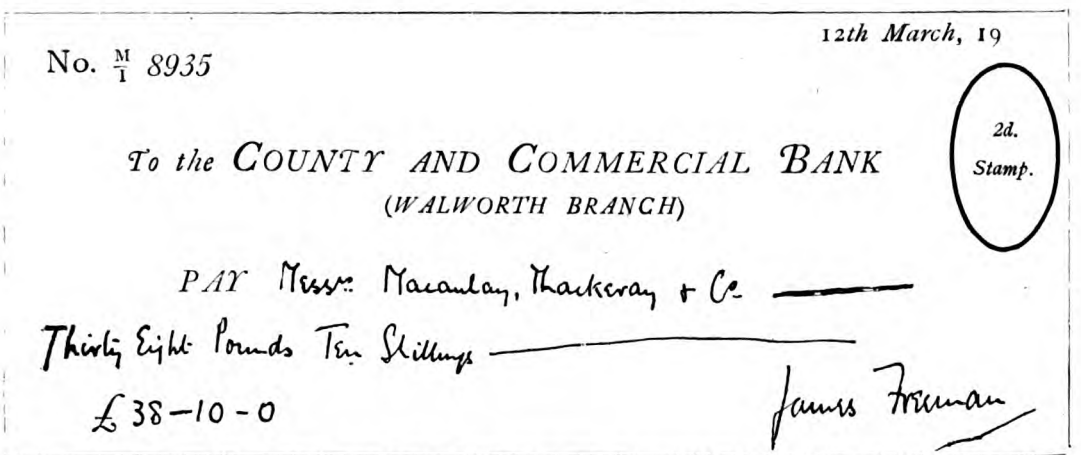
Depreciation is the falling off in value due to wear and tear and is a loss; this being so the Depreciation Account is debited, and the Real Account, representing the property which has depreciated, e.g. Plant, Machinery, etc., is credited.

It is no use keeping on the books as assets accounts which can never be collected; as soon as it is ascertained that a debtor cannot meet his liabilities, the amount owing by him, or such part of it as he is unable to pay, is written off.

This writing off is done by debiting a Bad Debts Account, and crediting the Personal Account of the debtor with the sum required to close the account. If the debtor can pay part of his debt, the amount thus paid is passed through the Cash Book, and posted to the credit of his account in the Ledger.

The balance, which then remains, represents the amount to be written off as a Bad Debt. If some part of the amount written off as bad is afterwards recovered Cash will be debited, and a Bad Debts Recovered Account will be credited.

A Complete Cash Book is one which contains three sets of cash columns on each side, one for discount, one for cash, and one for bank. In the discount columns, discounts allowed (losses) are debited, and discounts received (gains) are credited.



How to draw a cheque; the amount is expressed in writing as well as in figures.

The columns used for office cash are treated in the same way as a simple cash book. In the bank columns, payments into the bank are debited, whilst withdrawals by cheque are credited. It is necessary to make two entries for payments from the bank to the office or vice versa. The receiving account is debited, and the account which gives is credited.

Withdrawals from the bank for private purposes are entered on the credit side " By Drawings Account " in the bank column.

Banks and Banking

The bank is a place of business which deals with money in all its forms, such as coin, cheques, notes and the like.

The person who desires to open a banking account must either be personally introduced to the Manager, or provide satisfactory references.

There are two classes of accounts which a trader may open with a bank, viz. :—

1. Deposit Accounts, in which money is placed to the customer's credit for a specified time or subject to notice before withdrawal.

2. Current (or drawing) Accounts, which are opened for an indefinite period, money being paid in from time to time and amounts withdrawn by means of cheques. On providing suitable security (or cover), a customer may be allowed to withdraw a sum in excess of the amount deposited. This sum is called an overdraft, being in fact a loan for which the bank will charge Interest.

Every customer of a bank is provided with a Pass Book. Some banks arrange that the Pass Book shall form a record of the customer's personal account with the bank, in which case the deposits will be credited, and the withdrawals debited.

Money can only be withdrawn from the current account by means of cheques.

A cheque is a written order by a person (the *drawer*) to a bank (called the *drawee*) to pay on demand a certain sum of money to a specified person (called the *payee*) or to his order, or to bearer.

Every cheque bears a twopenny stamp.

When a cheque is made payable to a specified person " *or Bearer* " it may be cashed by any person into whose hands it may come, but when it is payable to a specified person " *or Order* " it must be endorsed by the Payee before it can be cashed. The endorsement consists of the name of the payee written on the back of the cheque, which then becomes payable to bearer. The banker takes such an endorsement as an instruction that he must pay the amount to the person presenting the cheque.

The great advantage gained by crossing a cheque is to make it impossible for the holder to receive money over the counter for it, and as this is deemed to be a desirable safeguard the practice of crossing cheques has now become almost universal.

A cheque is crossed by having two parallel transverse lines written across with or without the words " and Company," or any abbreviation thereof. The general effect of crossing a cheque is that such a cheque can only be paid through a bank and credited to a customer's account.

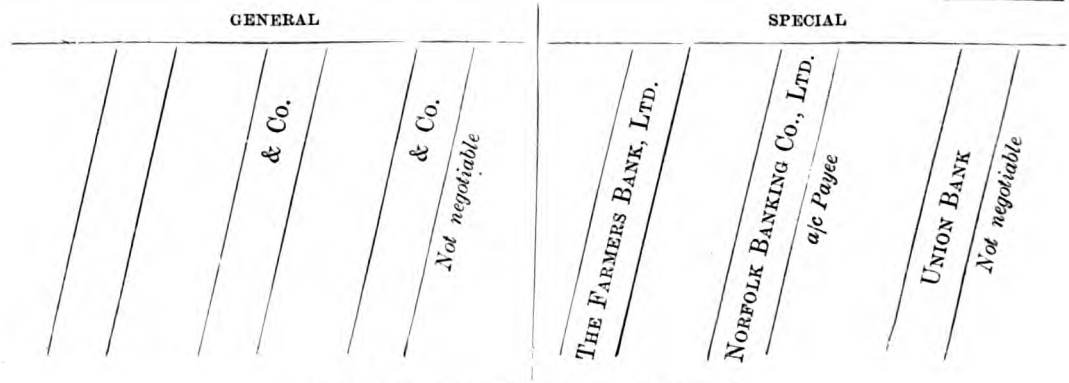
There are two kinds of crossings :—

1. General, where payment will be made through any bank.

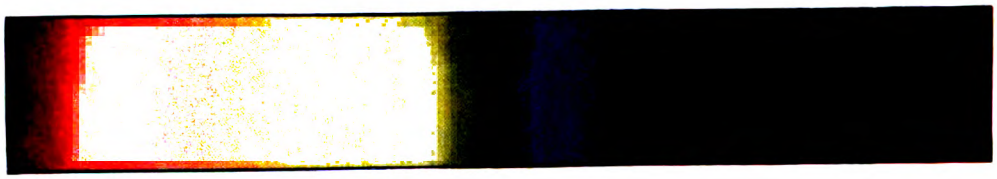
2. Special, where payment will only be made through the bank named in the crossing.

Definitions of Terms

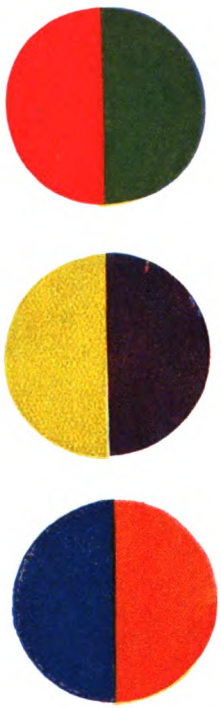
Goodwill is the value attaching to a business by reason of its continued trade, on the supposition that certain customers will continue their support of the business. F. H.



Examples of how cheques may be crossed.



The Colour Spectrum.



True Complementary Colours.
(Three examples.)

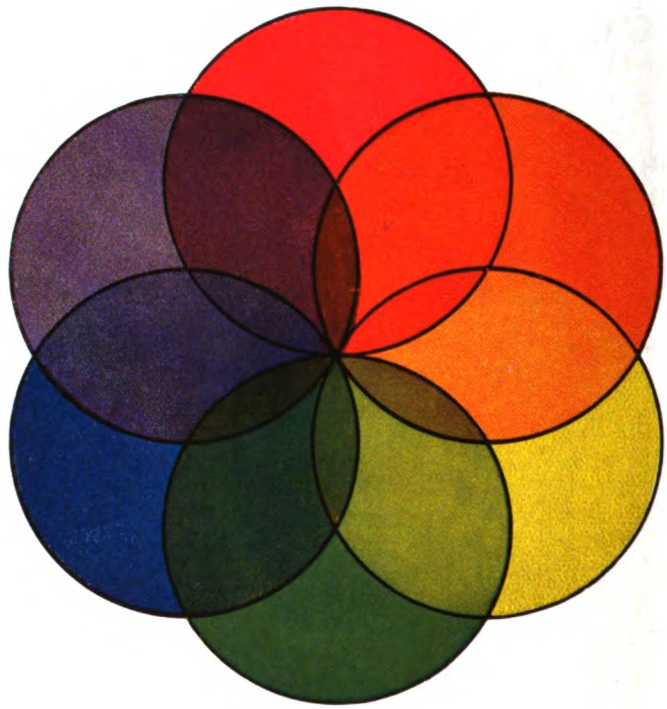
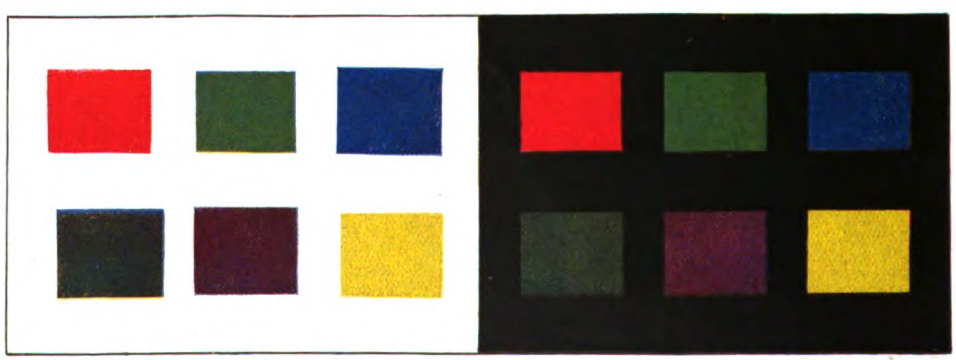


Chart showing Colour Combinations.



Showing how the same Colours are affected by the relation of Light and Dark Backgrounds.

Continued from page 60.

ENGLISH LANGUAGE AND LITERATURE:

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THE DRAMATIC WORKS OF SHAKESPEARE—II

WE have now reached the beginning of the second period of Shakespeare's literary career, when his most charming work was to be done, work that proves his wonderful breadth of mind, range of imagination, and grace of style rather than the profundity which, later, endowed him with an unapproachable greatness. Samuel Johnson, the most honestly narrow of conspicuous critics, argued that Shakespeare is a better writer of comedy than of tragedy. Such support as Johnson could have found for this untenable contention must have been sought from the poet's work in the years now under review.

Incomparable Comedy

The plays to be noticed briefly are: *A Midsummer Night's Dream* and *The Merchant of Venice;* the two Parts of *Henry IV.*, introducing the incomparable Falstaff, and *Henry V.; The Taming of the Shrew, The Merry Wives of Windsor*, and, perhaps, *All's Well that Ends Well*, closing with the three romantic Comedies, *Much Ado About Nothing, As You Like It*, and *Twelfth Night.*

Some would date *A Midsummer Night's Dream* a little earlier than 1594 or 1595, where we are placing it. They see the shimmer of youth in the gossamer grace of its poetry, light as the airiest fancies of childish play; but Shakespeare always renewed his youth when his thoughts strayed to country life.

Greece is the nominal scene, but the texture of the play, human or fairy, is English to the last thread. It is the English Robin Goodfellow, "merry wanderer of the night," and no foreign elf, who mischievously entangles all the characters in a fairy spell; and the "hempen homespuns," who bring stolid humour into a world of lightsome fantasy, are plain English rustics, whose revels must have brought choice delight into the poet's boyhood. This play is only for those who can appreciate the rarest fragrances of poetry. If anyone would pull the petals of the flower with heavy fingered criticism, there can but be launched against him Puck's exclamation: "Lord! What fools these mortals be!"

The Merchant of Venice, with its delightful wording throughout, its continuous interest widely varied in character, its feeling in almost equal equipoise between comedy and tragedy until near the close, is regarded universally as one of the best balanced of Shakespeare's plays. The Merchant himself sounds at once a note of gravity, and Shylock's fate, social and personal, we feel, is pure tragedy. Bright comedy holds the stage whenever the charming figure of Portia appears, and she it is who not only dominates the crisis of the play, but makes for it a gentle and happy ending.

Shylock and Portia

The story was taken from old novels and plays, *The Jew*, and Marlowe's *Jew of Malta* more particularly, furnishing suggestions. Shakespeare, as was his custom, took any suitable rough material he found ready to hand, and refashioned it with consummate skill into an entirely new work of art. The study of Shylock, with its under-current of sympathy for the Jewish race that at last makes us feel the old man's point of view is not wholly unnatural and perverse, and the finished portrait of Portia, beautiful, gracious, intellectual as well as witty, bountiful in spirit as well as in purse, stamp themselves indelibly on the mind of every reader or spectator, and a poetic grace irradiates the play like spring sunshine.

The two parts of *Henry IV.* and *Henry V.* form a continuous play, to which *Richard II.* is an Introduction. Shakespeare wrote these plays, obviously, with a whole-hearted interest. The characters of Hotspur and Henry V. are sketched with a fine boldness and vivacity. In no part of the poet's work is there a more sustained vigour.

The weaving of the comedy of Falstaff into *Henry IV.*, like weft and woof, managed with masterly skill, serves for much more than a foil to the general seriousness of history—it is essential to the study of the character of Henry V., in whose conquests in France all the historical writings of Shakespeare culminated. Although Henry does not fully retain the reader's sympathy, for he is a plain man who lacks some of the niceties of honour, and inherits a part of the hard unfaithfulness of his father, yet he is an heroic figure in a crisis, and is used magnificently to express the passionate patriotism which thrilled England in the days of Shakespeare.

Falstaff in Love

According to tradition the *Merry Wives of Windsor* was written to meet the wish of Queen Elizabeth, who asked to see Falstaff in love; and the writing—almost entirely in prose—is said to have been completed in a fortnight. Though the play introduces a circle of life that would otherwise be absent from Shakespeare—that is, the rural middle-class—it comes near being one of the plays that might have been lost without being greatly missed. For the Falstaff who is bemauled in *The Merry Wives* is certainly not the Falstaff who, with gusto, played up to a roving Prince and more than held his own. We cannot imagine the butt in the comedy taking his seat in imitation of a king, and with humorous gravity calling a madcap prince to account.

Harry, I do not only marvel where thou spendest thy time, but also how thou art accompanied; for though the camomile, the more it is trodden on the faster it grows, yet youth, the more it is wasted the sooner it wears. . . . There is a thing, Harry, which thou hast often heard of, and it is known to many in our land by the name of pitch; this pitch, as ancient writers do report, doth defile; so dost the company thou keepest; for, Harry, now I do not speak to thee in drink, but in tears; not in pleasure, but in passion; not in words only, but in woes also. And yet there is a virtuous man whom I have often noted in thy company, but I know not his name.

Prince: What manner of man, an it like your majesty?

Falstaff: A goodly portly man, i'faith, and a corpulent; of a cheerful look, a pleasing eye, and a most noble carriage; and, as I think, his age some fifty, or, by'r lady, inclining to threescore. And now I remember me, his name is Falstaff. If that man should be lewdly given, he deceiveth me; for, Harry, I see virtue in his looks. If then the tree may be known by the fruit, as the fruit by the tree, then, peremptorily I speak it, there is virtue in that Falstaff; him keep with—the rest banish. And tell me now, thou naughty varlet, tell me, where hast thou been this month?

We cannot imagine the Falstaff who is made only for farcical sport in *The Merry Wives* so winning the regard of his inventor that when the time comes for him to leave the stage he dismisses him in the words of the hostess of the tavern:

'A made a finer end, and went away, an it had been any christom child. 'A parted just between twelve and one, even at the turning o' the tide; for after I saw him fumble with the sheets, and play with flowers, and smile upon his fingers' ends, I knew there was but one way; for his nose was as sharp as a pen, and 'a babbled of green fields.

A little earlier than the Falstaff plays, *The Taming of the Shrew* was written from an old play, a good deal of which is incorporated. Katharina, Petruchio and Sly are the characters that illustrate Shakespeare's own work.

Prelude to the Tragedies

The dating of *All's Well that Ends Well* has been much disputed. Probably it comes to us as one of the poet's earlier plays rewritten by him when his mood had changed. It does not rank with the plays that express natural relationship, and its central theme, the pursuit of a slip of a man unworthy of her by a clever woman, is not attractive.

The prelude to Shakespeare's splendid tragedies came in the form of his three most charming comedies. In *Much Ado About Nothing*, one of the most popular of his plays, from his day to ours, he sets his two principal characters to "beat each other with brains" in brilliant dialogue, and to cast over the play an intellectual glamour. At the same time humorous stupidity is inwoven in the piece, through the characters of Dogberry and Verges, and serves to unravel the plot where cleverness has failed.

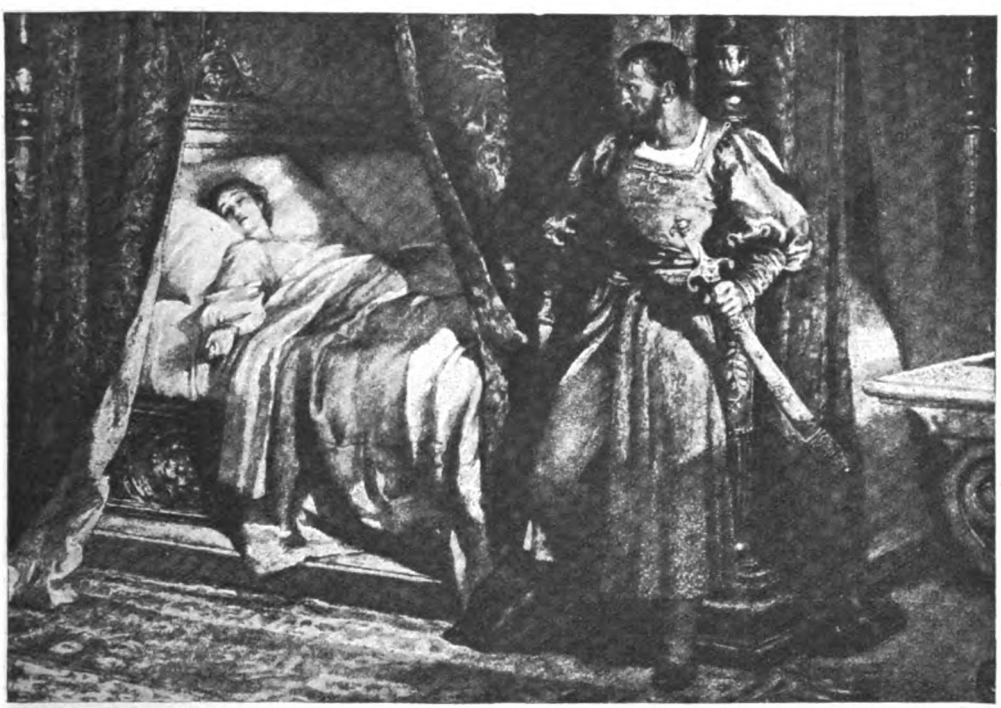
As You Like It is based on Thomas Lodge's romance *Rosalynde*, to which Shakespeare added the melancholy Jacques and the rural humours of Touchstone and Audrey. Refined comedy reaches its high-water mark in this delightfully finished play.

In *Twelfth Night* the Italian ideas of intrigue are mixed with broad English

From the painting by E. Grutzner.

THE MOCK TRIAL OF PRINCE HAL BY FALSTAFF.

Falstaff: "Harry, I do not only marvel where thou spendest thy time, but also how thou art accompanied." (*I. Henry IV., Act II., Scene IV.*)



From the painting by Frank Dicksee, R.A.

THE GREAT SCENE IN DESDEMONA'S BED CHAMBER.

Othello: "Yet I'll not shed her blood,
Nor sear that whiter skin of hers than snow."
(*Othello, Act V., Scene II.*)

humour. Merriment and sadness are close companions, and both notes are heard in the midst of the lyrical grace of its songs. Shakespeare was feeling strongly now that "Youth's a stuff will not endure," but, far more than that, he found himself confronted by "the mystery and cruelty of human life."

Thoughtful attempts have again and again been made to find in Shakespeare's own life occurrences that turned his thoughts to tragedy, but the connection between personal calamity and the poet's artistic presentation of the dire effects of human weakness, folly, cowardice, jealousy, and ambition has never been traced clearly. Whatever may have been the reason, whether it was the personal touch of disappointment and sorrow, for six or eight years after 1600 the poet's mind turned to the great agonies of fate.

Julius Cæsar

The first of the noble tragedies was *Julius Cæsar*. The materials for the play were ready to hand in North's recently published translation of Plutarch's *Lives*. It is the play of motive and sentiment around the great general's death, and their consequences, that constitute the drama, and not Cæsar's character or life. The clue to the story is in the last speech but one of the last Act—Mark Antony's epitaph on Brutus:

> This was the noblest Roman of them all.
> All the conspirators, save only he,
> Did that they did in envy of great Cæsar;
> He, only, in a general honest thought,
> And common good to all, made one of them.
> His life was gentle; and the elements
> So mix'd in him, that Nature might stand up
> And say to all the world, "This was a man!"

How noble Brutus was is seen earlier in the Act, when, bidding farewell to his friends before his death, he exclaims:

> Countrymen,
> My heart doth joy, that yet, in all my life,
> I found no man but he was true to me.

Yet he had been played upon continually for sinister purposes by men whose duplicity he was too honest and noble to suspect. The tragedy throughout is not the death of Cæsar, but the misuse of a pure-minded, simple theorist by astute practical men with ulterior aims.

Hamlet was produced almost contemporaneously with *Julius Cæsar*. Of all the plays it has most fascinated the world. Yet it has few of the features of the compactly framed play. It strews the stage with corpses, and answers none of the many questions it raises. Its interest is in its great and grave uncertainties. "To be or not to be, that is the question" is the key-line to the whole. It presents the tragedy of irresolute thought. With such analytical subtlety is the character of Hamlet himself suggested that it has ever since been a subject of world-wide discussion, while the reflections casually cast about as the play proceeds have by the hundred become proverbial possessions of all intelligent men.

In connection with *Hamlet* mention may be made of the part played in the Elizabethan drama by soliloquy. Shakespeare used soliloquy by his principal characters, not only to hint to the audience what they might expect in the development of the play, and to give clues to the state of feeling of the speakers-aloud of inmost thoughts, but sometimes a dominant theme was dwelt on in soliloquy so as to give moral atmosphere to a scene, in a manner reminiscent of the Greek chorus; and there is reason to believe the audiences hung breathlessly, in those days of budding but exuberant literature, on monologues that would now be thought somewhat long.

Macbeth and *King Lear*

Several plays of this time, or a little later, may be passed with briefest reference. *Troilus and Cressida* is an incomplete and unsatisfactory handling of a subject that had been much more finely treated by lesser writers than Shakespeare. *Timon of Athens* and *Pericles* were both largely the work of other writers, and cannot be accepted as representative of the Shakespeare who dominates the drama of the world. *Measure for Measure*, a bitter comedy on chastity, false and true, is one of the poet's cleverest, but least broad-minded, of plays.

We now reach the three plays in which the most poignant intensity of tragedy is attained—*Othello*, picturing the devastating effects of jealousy on a passionate creature that was true, simple, loyal, and unsuspecting till suddenly poisoned, and then became "perplexed in the extreme"; *Macbeth*, picturing the effects of unscrupulous ambition on two contrasted natures, the imaginative husband and the unimaginative wife; and *King Lear*, picturing the havoc wrought in a haughty and wilful mind by relentless ingratitude. In each case the drama is one of character—harrowing conflict in the arena of the soul—and in no sense dependent on incident.

Both *Othello* and *Macbeth* are finely

From the picture by Emile Bayard.

TOUCHSTONE, AUDREY AND WILLIAM.

Touchstone: "**. . . . I will kill thee a hundred and fifty ways; therefore tremble and depart.**"
Audrey: "**Do, good William.**" (*As You Like It, Act V., Scene I.*)

From the picture by Emile Bayard.

CELIA AND ROSALIND.

Celia: "**O, my poor Rosalind! Whither wilt thou go?**"
(*As You Like It, Act I., Scene III.*)

drafted for stage purposes, moving forward directly and swiftly, as if they had been conceived at once as a whole, and had been written under the first impetus of a great conception. *King Lear*, in its desolating agony, almost passes the limits of the actor's powers. It is too terrible to see.

> Vex not his ghost; O, let him pass! he hates him
> That would upon the rack of this tough world
> Stretch him out longer,

exclaims the faithful Kent when Lear is dying, and the truth of it is felt in every fibre of a reader's nerves.

All the plays sustain a high and level flight, far above commonness, however rough their few humours may be. A sense of inexorable fate broods over them. Othello murders with a supreme dignity. Even in the weird witch scenes of *Macbeth*, that fitly introduce premeditated crime, there are powers stranger and stronger than theirs astir.

> Though his bark *cannot be lost*,
> Yet it shall be tempest tost,

is the full extent of their malign influence.

Characters in Conflict

These plays show us "man's unconquerable mind," battling with a world of troubles, the fool of passion, of false aims, of puerile whims, and overthrown, but not bereft of manliness. Othello dies, but leaves us with hearts burdened with pity; Macbeth meets his deserved fate defiantly and never gives in; Lear has won his way through to a sympathetic world when the strain of sorrow proves too tense for him. In each case the struggle has been titanic. The powers of evil have not won a gloating victory. The sacrifices have not been made in vain. And we, the spectators, have been made to feel that we have stood for a space on the border-lands of the demi-gods.

Shakespeare now, still in the tragic vein, turned once more to Roman history, and with Plutarch as his treasury of information, produced the fine imperial play of *Antony and Cleopatra*, to illustrate the demoralisation that comes with pleasure and a maudlin surrender to the senses; and then closed his gloomier writings with the picture of the downfall of the pride of individuality and of class in the anti-democratic Roman play of *Coriolanus*.

Much rash surmise has been used in trying to gather Shakespeare's personal opinions from the opinions expressed by characters in his plays, but these guesses are all unconvincing. It has been said, for instance, that a dislike, and indeed contempt, for crowds can be clearly read in his treatment of the populace in both *Julius Cæsar* and *Coriolanus*.

It is well to guard against all such personal inferences. The excitability and inconstancy of Roman crowds was historically notorious; but, besides that, King James, one of Shakespeare's strongest admirers and supporters, included among his many foibles an instinctive revulsion from crowds and a suspicion of their intentions. That may have had some effect on a play produced by "His Majesty's Servants." *Macbeth* is supposed to have been staged as a compliment to the Scottish origin of the King.

Except for writing, to no great extent, in collaboration with Fletcher, on *Henry VIII.*, *Coriolanus* was the last historical play on which Shakespeare's pen was engaged.

The Enchanter's Wand

There remain only the three Romances n which the poet, writing from his retirement at Stratford, seems to have pleased himself.

In *Cymbeline* he takes us to legendary British times, with Hollinshed as his authority, and with this native story interweaves another from Boccaccio. The play shows a falling off in constructive power, but not in poetical feeling.

A Winter's Tale, founded on a romance by Greene, takes its colouring from the country scenes in the midst of which Shakespeare was renewing his youthful memories. It is brightened by the introduction of Autolycus—a new kind of rogue.

But the most characteristic production of the poet's later years was *The Tempest*. Obviously it was designed to bring the plays to a close. Prospero announces the burying of his enchanter's wand, and declares "Our revels now are ended."

And what a play it is as a grand finale! In it appear all the qualities, except tragic intensity, that have been seen in the whole range of the Shakespearean drama.

When we think of Shakespeare as a dramatist, he stands absolutely alone amongst modern writers. In an age that expressed itself more fully in the drama than through any other form of utterance, and that shaped him by its tastes, its outlook, its aspirations, he stood alone. Still less has any later writer approached him in range, or power, or varied grace. All that he wrote was literature; much was superlative literature. In his greatest work the human mind reached perhaps its highest tide-mark.

J. D.

THE ENGLISH LANGUAGE.—VII

LANGUAGE exists in order to enable people to exchange ideas with one another, either in speech or in writing; and the rules of the English language which we have been hitherto considering have been evolved during many centuries of use: they are not arbitrary laws laid down by pedantic scholars, but the necessary conditions and conventions under which the language exists as a medium of intercommunication among Englishmen. Still, they are but the means to an end; and that end is the expression of our thoughts in a form which is both intelligible and agreeable.

The first aim of a writer or speaker is to be *clear*, to avoid ambiguity and uncertainty in the expression of what he has to say, to convey to the reader as exactly as possible what is in his mind. This is the cardinal test to be applied to all composition in language, whether written or spoken. It must avoid vagueness and obscurity of meaning; if it does not, it must be rewritten and recast until it does.

Use of the Simple Sentence

The unit of composition is the sentence, and the art of composition consists, in its fundamental elements, in the organisation and suitable correlation of sentences. It is the opposite process to that considered in our previous lesson. There we were concerned with analysis, a decomposition of the word-edifice: here our aim is a synthesis, a building-up of the complex from the simple.

Now, doubtless we could so fashion all our thoughts that they fell into a series of simple sentences; and sometimes this is an effective vehicle of expression. It is adopted by writers who wish to give exceptional vividness and force to their statements or descriptions. The bare simplicity of the sentence-structure, sharply repeated, has the effect of a series of sharp blows or flashes upon the mind. But for most purposes this method is unsuitable: it becomes monotonous and wearisome, and in the end our attention is lost. Consider, for example, the following string of simple sentences:—

(i) The man was sitting in his chair. He had been reading for two hours. He was tired of his book. It was not particularly interesting. He suddenly made up his mind to go for a walk. It was raining. He walked four miles. He returned to his book with new zest. He read till midnight. He then went to bed.

The meaning of all this is quite clear, and so far it is satisfactory. But it is also painfully obvious that the expression is weak and halting; the simple sentences are such as a child might use, and such as a beginner in composition naturally would use. They show no relationship between one statement and another. The whole connected series of incidents lacks unity: the expression, in short, does not adequately represent the facts; and the simple sentence, used without variety or change, generally fails in that respect. If, however, we rewrite the sentence as under, we have come nearer to the spirit of the episode:—

(i) For two hours the man had been sitting in his chair, reading, when, tired of his book, which was not particularly interesting, he suddenly made up his mind to go for a walk. Although it was raining, he walked four miles; and, returning to his book with new zest, he read till midnight, when he went to bed.

Here we have a complex sentence and a compound sentence, instead of the bald string of simple sentences; and the expression is at once more elegant and more exact. Thus, while we must aim at simplicity, we must also have *variety*; and this is obtained by suitable use of the more complicated types of sentence. Brevity and point are good qualities; a short sentence, so long as it does not become bald in its conciseness, is to be preferred to a long and rambling one; and poverty of ideas cannot be covered by a multitude of words. Nevertheless, the short and simple sentence cannot do everything; and careful attention must be paid to the building-up of more complex units.

Periodic and Loose Sentences

The complex sentence is capable of infinite variations in length and intricacy of structure; but there are two main types, the periodic and the loose.

The periodic sentence, or period, is especially appropriate in dignified or rhetorical language. In it, the principal clause, containing the chief and most important statement, is reserved for the end of the sentence, *i.e.* for the most emphatic position. Thus the mind is kept in a state of expectancy, waiting for a climax. The subordinate statements accumulate their effects, and the force of the sentence continues to grow till the end is reached. As a simple example, take the following:—

(ii) If a man acknowledges no sense of responsibility to his country, but, when a foreign enemy is at the door, refuses to emerge from the shell of his selfish pursuits, which in ordinary times may

be perfectly harmless, and indeed profitable to the community, he supplies the strongest argument for a suitable measure of compulsion.

It is needless to emphasise the strong point of such a sentence as this : the withholding of the main idea till the last is undoubtedly effective. But it also illustrates the danger of the periodic sentence. In the multiplication of subsidiary clauses or phrases, there is always a tendency for the grammar to become confused, and the whole structure is in peril of being overbalanced by the subordinate preliminaries. For these reasons, the period is not so common in ordinary English prose as the loose sentence.

Flexible Writing

In the loose sentence the main idea is expressed at once, and the subordinate statements follow. Such a sentence is freer and more flexible than the more polished and formal period ; but it brings in its train the danger of drifting and indefinite expression. There is a tendency for it to end weakly on some comparatively unimportant detail, so that the last impression left on the mind after reading the sentence is not that which was intended. If, however, this tendency is avoided, the loose sentence is usually preferable to the period : it is less finished, but also less stilted. As an example, we may recast (ii) into the form of a loose sentence, as follows :—

(iii) That man supplies the strongest argument for a measure of compulsion who acknowledges no sense of responsibility to his country when a foreign enemy is at the door, but refuses to emerge from the shell of his selfish pursuits, which in ordinary times may be perfectly harmless, and indeed profitable to the community.

The thought is expressed with equal clearness in both sentences : we leave it to the student to decide which of the two has the more powerful effect. Generally speaking, the period is most effective in argumentative prose ; while the loose sentence is better adapted for descriptive or narrative composition.

The distribution of emphasis in a sentence is an important point for consideration. The end of a sentence is normally the most emphatic place ; consequently a sentence should not end with a long trail of insignificant words, such as prepositions or auxiliary verbs : e.g.

(iv) My box has a handle to pick it up with.

Next in importance to a suitable ending is a suitable beginning, which is second in force of emphasis to the end of the sentence. The main point of a sentence must not be buried between a weak introduction and an unemphatic close. Special emphasis can, however, be given by any variation in the normal order of words, or even by a complete inversion of that order : e.g.,

(v) Friends they call us ; but we do not deserve the name.

(vi) From his friend came the worst treachery.

In giving emphasis to certain words or phrases, we must be careful not to upset the proper balance of the sentence. A harmonious balance must be maintained both in the meaning and in the movement or rhythm of a sentence. Emphasis, in fact, must be so adjusted that the sentence is not overweighted unduly in any part ; it should not produce the effect of a sudden blow or crash, but rather that of a beat in music or an accent in verse, giving its due effect to each part of the sentence.

Sometimes the parts of a sentence are balanced with especial care, word against word, or phrase against phrase, so as to gain the effect of suitable contrast or comparison. This is called antithesis : e.g.,

(vii) Cautious and patient in counsel, brave and resolute in action, the general achieved a victory impressive and complete.

(viii) As a statesman he was plausible and unreliable, as a man cowardly and dishonest.

In these examples, it is evident that the writers have taken pains to balance their adjectives in corresponding pairs, with the idea that they shall be more effective and precise in their application. This kind of exact balance may, however, become merely mechanical and, consequently, monotonous ; and it is at its best an ornament rather than a necessity for the clear building of the sentence.

The Paragraph

A collection of sentences bearing upon a single theme forms a paragraph. In its simplest form, a paragraph may be constructed out of a single sentence ; but in general the composition of a paragraph demands a number of sentences, organised into a logical unity. In the development of a sentence we have to consider the same points on a smaller scale as in the architecture of the paragraph ; but in the latter case, our concern is much less with the grammatical coherence of words and phrases, and chiefly with the ordering and appropriate development of our ideas. Thus, while a sentence is often employed to express a complex thought, the paragraph contains

a complex idea, in which many simpler ideas, each developed in simple or complex sentences, are correlated; the unity of a paragraph is a complex logical unity, and its balance or harmony results from the due weight being given to the component ideas and to the sentences which express them. We may say this simply by remarking that the unity of the paragraph demands that all the thoughts expressed must serve to expound or illustrate a single theme. In a well-constructed paragraph, we ought to be able to find this central idea, and to show how the various parts of the paragraph are related to it.

This unity of the paragraph is a more important matter in good composition than its length. As in the case of the sentence, the length of a paragraph must be decided by the nature of the ideas to be expressed. A short paragraph, consisting of a few loosely connected sentences, may put a larger tax on a reader's attention and patience than a closely knit long paragraph. Nevertheless, the long paragraph will usually contain more pitfalls for the careless, and as soon as it begins to exceed a dozen lines or thereabouts it should be watched with especial care, lest its later parts run out of harmony with the earlier. The intrusion of alien ideas or awkwardly placed sentences, which do not dovetail with the main structure, even when they are punctuated into a parenthesis, irritates and wearies the reader.

Unity and Development

The development of a paragraph may proceed by various methods. We may either, following the analogy of the sentence, develop it loosely or as a prolonged period. In the first case, we shall state, concisely and in general terms, the main theme of the paragraph in the opening sentence, and build around this central nucleus of thought. A suitable opening sentence always arouses interest; it holds the position of especial emphasis, ringing the bell, as it were, for the entertainment that is to follow. Even when the method of the period is followed, and the chief weight of the paragraph thrown to the end, an attractive opening sentence is essential. Indeed, in both forms, we must have strength at each end of the paragraph, for those are the emphatic positions.

Just as there must be coherence among the sentences within the paragraph, so there must be coherence between the various paragraphs of a composition. In structure a paragraph may be considered as a unit; but it is a unit which contributes to a larger whole. We must consequently arrange for suitable transitions between one paragraph and that which follows. These transitions require skill and attention: if they are not attended to, the composition will be irregular and abrupt, and the mind of the reader irritated as by friction. The succession of ideas should *flow* from point to point, rather than proceed in spasmodic leaps.

A Flowing Style

Reverting to the internal development of the paragraph, we have various methods at our disposal, each of which is appropriate to a particular type of theme. If we are to describe, for example, the contents of a room, we should proceed probably by the accumulation of detailed points that bear upon the theme. The chief consideration in this method is the proper grouping and arrangement of the details; we might proceed from the larger and more conspicuous details to the smaller and less significant, ending with a resumé which might serve to impress the effect of the whole; or we might proceed in the reverse way, passing from small to great, and reaching a climax at the end of the paragraph. In either case the proper effect of the paragraph is obtained only by attention to proportion and balance.

Another method of procedure, which applies smoothly to the treatment of a general idea, is that by the citation of suitable examples or instances. The idea contained in the aphorism, "An honest man's the noblest work of God," might be well developed in this way, either through anecdotes or by more specific points bearing upon the idea.

The subject last mentioned would lend itself also to a third method of paragraph-development, namely, the method of the opposite. A series of sentences might state several points which show what an honest man is not, so that we may gather by inference what he is. Such a paragraph might be made very effective, especially if the positive point is clearly brought out at its close. It is valuable particularly in oratory or other forms of rhetorical exposition.

Some themes are most appropriately developed by a method of comparison. The comparison should be suggested in the first sentence of the paragraph, and each sentence that follows should bring out clearly one point in the comparison. Once started, the method must be maintained throughout the paragraph, and the conclusion of the comparison should be clearly brought out in the final sentence. E. W. E.

From the picture by James Archer, R.S.A., by permission of the Autotype Co.

PETER THE HERMIT PREACHING THE FIRST CRUSADE (1095-1099).

This remarkable man succeeded in rousing Western Europe to something approaching religious frenzy. He addressed himself mainly to the riff-raff of society, and enrolled under his banner a huge vagabond army, representative of the very dregs of poverty, ignorance and crime.

Continued from page 65.

HISTORY:

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THE CRUSADES.—I

MAHOMET, the son of a Christianised Jewess and her husband, Abdallah, an idolater, was born at Mecca in Arabia about 570 A.D.

At the age of thirteen he became engaged in trade, being apprenticed to his uncles Abu-Talib and Abdall-Motalleb. When still quite young, however, he married; and his wife, Kadijah, although a widow and old enough to be his mother, had at least one attraction for young Mahomet. She was immensely rich.

After his marriage, therefore, her husband found himself in a position of considerable affluence, able thenceforth to give himself more to study and contemplation than to the performance of irksome commercial duties.

Every year he retired to a cave near Mecca, and there spent a whole month in solitude and prayer. His mode of life during this month he kept secret from everybody; but on returning from one of these sojourns he announced that the angel Gabriel had come to him, and had taken him into the presence of God, who had appointed him His prophet. The *Koran* contained the revelations which the angel Gabriel, as the mouthpiece of the Almighty, was supposed to have made.

Mahomet, Prophet of God

The first to believe in Mahomet as the prophet of God was his wife Kadijah, whose example was followed by several of Mahomet's kinsmen. The people, however, were slow to accept him, and his doctrines so much scandalised the authorities at Mecca that, after a short time spent preaching there, Mahomet was forced to fly for his life to Medina. This was the celebrated *Hejira*, or Flight, from which the Mahommedans calculated their era.

At Medina Mahomet soon gained many disciples. The place became the nucleus of the prophet's power. Thither flocked converts from all parts of Arabia; and before long Mahomet found at his disposal so numerous a body of armed men that he was able to begin hostilities against Mecca, whose people had expelled him from their midst, and finally was permitted to make a triumphal entry into the city in the capacity of prophet.

Conversion by the Sword

This was the great event in Mahomet's life. From that time he became the most powerful prince in all Arabia; and, with the number of the "faithful" increasing by thousands daily, began to turn his thoughts towards spreading his doctrines beyond the limits of his native country. To "the people of the book," that is to say, to those who claimed to have had some special revelation, as did the Christians and the Jews, Mahomet allowed his followers to show toleration in return for the payment of tribute; but to idolaters of all kinds the message which he brought offered a choice between two alternatives only—Death or the *Koran*.

On June 8, 632, the prophet died—from the effects of poison, administered, it is said, by a Jewess who wished to prove whether he actually was, as he asserted, the Messiah that should come into the world.

A period of discord followed, but eventually the supreme command over the faithful devolved upon Abubeker, the father of Ayesha, who had been Mahomet's favourite wife during his later years.

Abubeker soon crushed by force of arms the efforts of rivals to depose him, and, assuming the title of Kaliph, proceeded to enlarge the borders of the Saracenic Empire. Making wise choice of commanders, chief of whom was the mighty Khaled, "the sword of God," he invaded Syria, Babylonia, and the nearest provinces of the Eastern empire, and covered the Saracen arms with the laurels of victory. Damascus and Jerusalem were both attacked, and the former,

though the Emperor Heraclius sent an army of 100,000 men from Constantinople to relieve it, was captured on the very day that Abubeker died (A.D. 634).

Under Omar, the successor of Abubeker, Persia, Egypt, and Syria were added to the Saracen dominions, Jerusalem itself falling into the Kaliph's power in the year 637. Upon the spot where Solomon's temple had stood the great mosque of Omar was built. Christians, however, were afforded protec-

A page reproduced from an early printed edition of the *Koran*.

tion in return for tribute; and, under the strong, just rule of the Kaliph, Jerusalem prospered as it never had while its affairs were directed by the slothful provincial governors appointed by the Emperor.

From the death of Omar in 643 until the invasion of Spain in 710 the Saracens continued to extend their empire with but little intermission. In addition to establishing themselves along the coast of northern Africa, they mastered the islands of Sardinia, Sicily, Rhodes, and Crete, and even effected a lodgment on the Italian peninsula. From the shores of Morocco, moreover, they looked northward towards Spain; and in 710, under the leadership of Tarik (whose name is preserved in that of the rock of Gibraltar, called by the Saracens *Gibel-al-Tarik*), a resolute band, eager to spread the religion of their prophet by fresh conquests on the continent of Europe, crossed the straits and, assisted by reinforcements of their countrymen, soon subdued the Gothic kingdom of Spain.

So soon as they had settled their new territory into something like order, the invaders looked round for yet other conquests, and, marching across the Pyrenees, pushed as far north as the Loire, sweeping resistance before them until, in 732, they met near Tours the great army which Charles Martel (*see* Vol. I., p. 268) had raised to check their hitherto invincible progress.

The Battle of Tours

The titanic struggle which followed between Mahommedanism and the forces of Christian chivalry lasted for seven days. It was perhaps the most momentous battle in the history of the world, and was contested with a terrible intensity; yet, despite their indomitable courage, the Saracens were forced slowly to yield ground until finally, after the death of their leader, Abdalrahman—a general of much resource and spirit, who fell mortally wounded at the critical stage of the conflict—they were put to flight. Their shattered army was then hurled in disorder back across the Pyrenees, where, in the quiet of its Spanish provinces, it sought to be healed of the wounds which "so bloodily did yawn upon its face."

The Moslems never again attempted to invade central or northern Europe.

Still, their empire had made very considerable progress. Those years of development, however, were also years of division. As the Saracen power spread, a number of warlike chiefs arose, each of whom claimed the throne, and each of whom was prepared to support his claim by an appeal to arms. In this way, quasi-independent kingdoms came into being in Tunis, Tripoli, Egypt, Morocco, Damascus, and Spain. Each was under the rule of some successful soldier-chief, and by the middle of the eighth century the authority of the Kaliph at Bagdad, the nominal "Commander of the Faithful," had practically been set at nought, and his dominion had become confined to the limits of the city itself.

This splitting up of the unity of the Saracenic Empire was for a while the salvation of European civilisation. But there

was also another and more deadly cause for the decline of Mahommedan power. As a result of contact with civilisation and refinement, the Arabian soldiers lost much of that simplicity and hardihood which at one time had rendered them almost unconquerable; and the Kaliphs, during the course of subsequent wars, were forced to enrol as mercenaries in their armies stalwart warriors from among the barbarous people dwelling in Turkestan.

These men were Tartars of the strongest, roughest kind; and, having accepted the conditions imposed on them, came to be regarded as the household troops of the Kaliph. But from being guards they soon learned to become masters; and at about the time when the more vigorous Saracen armies were overrunning Spain, the Turks succeeded in acquiring an almost complete supremacy in Bagdad.

From that time the Kaliphate visibly declined; and although the Turks preserved the office for their own nominees until 1258, in order to give some legal title to their authority, Al Radi, who died in 940, was the last of the real Kaliphs.

After him there was no true head of the Empire, and the Turks, receiving every year large reinforcements of their own countrymen, steadily consolidated their power. They borrowed from the Saracens most of what was valuable in their system, and they adopted the Mahommedan religion; but they were careful to preserve the hardy principles and practices of their native country.

Now and again they were attacked by the more energetic of the Emperors, who periodically sent armies from Constantinople in the hope of retrieving ground that had been wrested in the past from feeble provincial governors. Not infrequently the Turks gained by those attacks; but, whether they gained or not, they always noted down the aggression as a thing to be paid back with interest some day. And that day came when —some three centuries after the Turks had become a power in the world—Constantinople fell into their hands.

The various Saracenic kingdoms continued to exist as more or less separate entities for a very long time. The Turkish Sultans of Egypt, however, came gradually to assume the lead among them, and, as the Bagdad Empire fell to pieces, to absorb some of its provinces—notably Syria.

From the painting by John Pettie, R.A.

THE PALMER.

A common scene in any of the great houses of twelfth century England—a Palmer (i.e. a pilgrim who had journeyed to the Holy Land and returned home with a palm) relating to a knight, his lady and son, the story of his adventures in a land in which the knight had fought, or surely was about to fight.

The Arabs, who overran Syria in the seventh century (soon after the death of Mahomet), respected for the most part the religion or liberties of the Christian inhabitants of the country; but in the eleventh century, with the coming of the Seljuk Turks, there began a period of persecution and oppression. In 1071, moreover, by reducing Asia Minor and establishing themselves at the fortress of Nicæa, separated only by the Bosphorus from Constantinople, the Turks became a serious menace to the Eastern empire, and the Emperor Alexius, who ascended the throne in 1081, appealed to Pope Urban II., as the head of Christendom, to assist him in his endeavours to repel the infidel.

Peter the Hermit

The Pope listened to the appeal, and in 1095 summoned a great ecclesiastical council at Clermont in France to discuss the question. This was the beginning of the Crusading movement. Thousands of people flocked to Clermont to witness the proceedings, and at the tenth meeting, which was held in the great square, Urban himself addressed the assembly from a throne which had been planted on a lofty scaffold.

In a long and laboured speech he dwelt on the alarming progress that had been made by the Saracens and Turks—whom, by the way, he appears to have regarded as almost identical—and implored his auditors to cast away the fear of death, and to embark on a campaign against the infidel—a campaign, he declared, which would assure to all who took part in it the eternal joys of heaven. The Pope pledged the Church to protect the wives, children, and property of all Crusaders during their absence, and released them from the payment of interest upon loans. Before leaving for the East, he added, everyone should receive a sacerdotal blessing, and must wear a cross upon his breast when he went forth, and on his back when he returned, as a symbol of his sacred mission.*

The popularity acquired by the Crusading movement is one of the most remarkable phenomena of mediæval history. Peter the Hermit, and the other enthusiasts who set out to preach the Crusade, succeeded in rousing in Western Europe something akin to a spirit of religious frenzy, which the material inducements held out by the Church are quite insufficient to explain; and the general excitement was further stimulated by the Patriarch of Jerusalem, who travelled through Europe telling of the wrongs under which Christians were suffering in the Holy Land.

It was arranged that the relieving army should set out on the Festival of the Assumption (August 15), 1096, and that the chief command of the expedition should be entrusted to Godfrey de Bouillon, Duke of Lorraine.

It necessarily took time to complete the preparations for this great adventure, and under the strain of this delay popular impatience grew exhausted. The preaching of Peter the Hermit had penetrated the lowest depths of society, and people representative of the very dregs of poverty, ignorance and crime had enrolled themselves under his banner. In March, 1096, therefore, without waiting for the instructions of the leaders of the movement, a large number of these volunteers—peasants, labourers, and vagabonds, and even women and children—set out through Germany on their way to Constantinople.

The people who joined in this mad, wild enterprise, nearly 100,000 in number, were divided into three bodies, commanded respectively by a Burgundian knight, called Walter the Penniless, by Peter the Hermit himself, and by a priest named Gottschalk.

A Vagabond Army

While passing through Hungary, the followers of Peter the Hermit came to blows with the natives of the country, and having learned that their precursors, the band of Walter the Penniless, had been maltreated by them, avenged their fellows by acts of great atrocity. In Bulgaria a state of actual war broke out between the natives and the adventurers from Western Europe; and if the Bulgarians sought to stay the followers of Peter by every means within their power one really cannot blame them. They regarded the rabble of hungry fanatics in their midst as a horde of savages, and such indeed they were.

The news of their evil deeds went before them, and when at length the vanguard reached Constantinople, the Emperor Alexius made arrangements for the entire host to be hurried across the Bosphorus.

In Asia Minor things fared even worse. Peter the Hermit lost all control over his insubordinate levies, and finally returned to Europe, leaving them to be slaughtered by the Turks. Thus ended the first endeavour to rescue the Holy Sepulchre. J. A. B.

*It was this symbol which gave to the Christian warriors their distinctive title of Crusaders, the word being derived from the French *croisade* (Latin, *crux* = a cross).

Continued from page 87.

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CHEMISTRY.—XI

Salt and Spirits of Salt.—Common salt is one of the most widely diffused of all minerals. It is not only found in enormous deposits in the earth's crust, as for example at Wielizcka in Poland and at Northwich in Cheshire, but it is always present in all spring, river, and sea water. About two-thirds of the dissolved solids in sea-water consists of salt, and it is generally accepted that the land deposits, known as rock salt, were formed in bygone ages by the evaporation of seas which formerly covered the land.

Considerable quantities of salt were at one time obtained by the evaporation of sea-water, particularly in hot climates, but it is now obtained from rock salt deposits either by simple mining or by introducing water into the salt, pumping up the brine, and then evaporating it. It is one of the most useful of all minerals, being essential to the health of man and animals.

Enormous quantities are used in the manufacture of washing soda and allied products, and its uses for seasoning and preserving food are too well-known to need description. Common pottery, drain-pipes, etc., are usually glazed with it. Salt dissolves readily in water, and its solubility increases but very slightly with rise in temperature. It crystallises in cubes, which are colourless and translucent and possess a lustre like that of glass. The taste is characteristic and not easy to describe. The dampness of ordinary salt is chiefly due to impurities contained in it, and the practice of putting salt upon a wine-stain is due to the fact that salt keeps the spot damp, so that the colouring matter is more easily removed in the wash.

When rock salt crystals are heated, they usually jump about and omit a slight detonation, called "decrepitation," owing to the sudden expulsion of the water in the form of steam. The water found in salt crystals is not water of crystallisation, as the crystalline form is not lost by heating, nor are any of the other properties in any way altered.

On heating to a very high temperature, salt melts, and on cooling it re-solidifies in a crystalline mass. Very interesting is the action of sulphuric acid. A brisk effervescence takes place and a colourless gas is evolved which forms white fumes when it comes in contact with the air, these becoming more dense when they are breathed upon. The action may be tried in a test-tube, and it may be noted that the gas can be poured downwards into another vessel: it is therefore heavier than air.

The old name for this gas was "*Spirit of Salt*," i.e. a spirit or gas which the acid drove out of the mineral. We shall not use the name under which it is now generally known until we have found out its composition.

Experiment XXXIX.—*The Preparation and Properties of Salt Gas.*

Some salt is placed in a flask fitted with a cork which is traversed by a safety-funnel and a delivery tube. The latter has a right-angled bend and dips into a gas-jar, the mouth of which may be loosely closed by a piece of filter paper pierced by the tube. The flask can be supported by a wire-gauze placed on the ring of a retort-stand, for by using heat, more gas is obtained from the same amount of acid. Four or five jars should be filled by this method, which is called "*downward displacement.*"

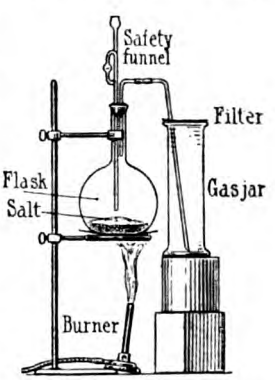


Fig. 16.—Apparatus for the preparation of Salt Gas.

A lighted taper is placed at the mouth of the jar: the gas does not ignite and is therefore incombustible. On inserting the light inside the jar, it is extinguished, therefore salt gas does not support combustion.

An inverted jar is placed with its mouth under water, the disc which covered it being quickly removed. Water rises in the jar very rapidly, showing that the gas is very soluble in water.

At the ordinary temperature 1 c.c. of water dissolves no less than 500 c.c. of the gas.

The solution turns litmus blue, and is therefore acid. It is commonly called "*Spirits of Salt*," or "muriatic" acid (from the Latin, muria: brine).

To make a sample, the gas should be passed downwards into water through an inverted funnel, which should not be entirely immersed. It will be observed that the acid appears to drop down through the water like an oily liquid, and that heat is evolved.

If a little of the acid be evaporated, it will entirely disappear and leave "not a wrack behind"; it is therefore volatile.

The fumes which are produced when salt gas comes in contact with air, consist of very minute liquid drops of the acid, formed by the gas dissolving in the moisture of the air.

The commercial acid has a yellow colour, due to the presence of iron, but the pure substance is colourless. Although it does not support life, the gas is not poisonous, the workmen in factories who are daily exposed to it, apparently only suffer from excessive appetite! The presence of a very small amount of acid in the gastric juice is probably connected with this fact.

The white solid remaining in the flask is called "*salt cake*," and is used in the manufacture of washing soda by the Leblanc process.

When soda was first made from salt cake, the salt gas was regarded as a useless by-product, and was consequently allowed to escape into the air; it caused so much nuisance, however, by corroding

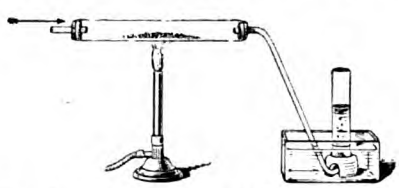


Fig. 17.—Apparatus for extracting hydrogen from salt gas.

iron-work and destroying vegetation, that some manufacturers adopted the expedient of passing the gas into the canals and streams, with the result that fish life was destroyed.

A big manufacturer then conceived the idea of passing the gas out of the factory through a very high chimney; but the fumes, being heavier than air, descended and the nuisance was as great as before. Finally, an Act of Parliament ordained that manufacturers were to "consume their own smoke." They therefore passed it direct into water inside the factory. It was not long after that spirits of salt was recognised as a very valuable substance.

Spirits of salt exerts a great corrosive action on most metals. Magnesium, zinc, iron, etc., dissolve in it with the evolution of hydrogen.

Experiment XL.—*To discover if Salt Gas contains Hydrogen.*

Salt gas is passed over iron filings contained in a hard glass tube which is heated by a hot flame. A delivery tube connects it to a gas-collecting trough. The iron becomes covered with a yellowish white, silky, crystalline deposit, some of which collects on the cooler parts of the tube. The gas which comes off is found to be hydrogen, the excess of salt gas dissolving in the water in the trough. (Fig. 17.)

A similar experiment should then be performed with sodium. In this case hydrogen is again evolved, and the metal glows as it is converted into a white crystalline product which tastes like salt. Therefore salt gas contains hydrogen.

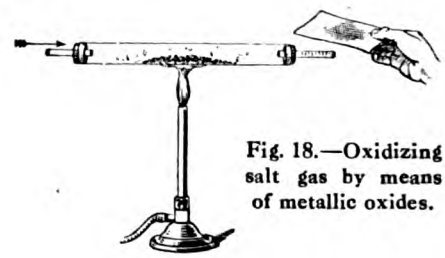


Fig. 18.—Oxidizing salt gas by means of metallic oxides.

But as the gas is not identical with hydrogen, it must contain at least one other constituent, which for the present we will designate "x." Our next object then will be to isolate "x," and we shall most likely succeed if we bring salt gas into contact with an oxidizing agent which would deprive it of its hydrogen.

Experiment XLI.—*To Oxidize Salt Gas by means of Metallic Oxides.*

The apparatus is the same as in the last experiment except that the tube and trough are omitted. (Fig. 18.) Oxides of iron, copper, lead, etc., may be tried. In nearly every case the oxide is changed and water is formed, but as no new form of matter is observed, the "x" must have combined with the metal.

An attempt should then be made with an oxide rich in oxygen, like barium dioxide, or manganese dioxide. Again we observe that an action takes place, and that water is produced, but at the same time a strong, unpleasant smell is perceived. If some litmus paper be held where the excess of salt gas emerges from the apparatus, it will turn first red and then white, i.e. it is bleached. This gas must then be the elusive "x." Its name is Chlorine, which was given to it on account of its greenish colour.

Salt gas is therefore composed of hydrogen and chlorine, and its chemical name is accordingly hydrogen chloride.

The solution of salt gas in water is called hydrochloric acid, and the compounds formed by the union of chlorine and metals (Experiments XL. and XLI.) are called chlorides.

We may now conveniently summarise some of the reactions investigated in the form of equations.

(1) Salt + sulphuric acid = hydrogen chloride + salt cake.

(2) Hydrogen chloride + water = hydrochloric acid.

(3) Hydrogen chloride + sodium = hydrogen + sodium chloride.

(4) Hydrogen chloride + copper oxide = water + copper chloride.

(5) Hydrogen chloride + manganese dioxide = water + chlorine + manganese chloride.

Experiment XLII.—*The Composition of Hydrogen Chloride by Volume.*

The easiest method of ascertaining the proportions in which hydrogen and chlorine unite by volume is to make use of the reaction given in Equation (3) above, only instead of applying heat the change can be effected at the ordinary temperature by previously amalgamating the sodium with mercury. Any alloy of a metal with mercury is called an amalgam.

In the present instance, the mercury does not undergo any change itself, it serves to increase the surface of contact between the sodium and the hydrogen chloride. To make the amalgam, small pieces of clean sodium are necessarily pressed with a pestle into mercury contained in a mortar.

To start with, the action is vigorous, a flash of light being observed and white fumes (which should not be inhaled) escaping. A long tube is filled as completely as possible with hydrogen chloride gas and firmly closed with a rubber stopper. The latter is removed and the liquid amalgam poured in as rapidly as possible and the cork again inserted. The tube becomes noticeably warm, the amalgam tends to adhere to the sides of the tube, and white particles of sodium chloride make their appearance.

To find the volume of gas left over, the tube is opened under water, and a rubber ring placed on the level of the risen water. It is found that exactly half the original volume of gas is left, and if it be tested with a light, it will be seen to be hydrogen. Therefore any given volume of hydrogen chloride contains half its volume of hydrogen, and if we assume that the other half is only chlorine (and it can be easily proved), it follows that 2 volumes of hydrogen chloride consist of 1 volume of hydrogen and 1 volume of chlorine.

Experiment XLIII.—*The Composition of Hydrogen Chloride by Weight.*

About 0·3–0·5 grams of zinc is accurately weighed out and dissolved in a little hydrochloric acid in the apparatus described for Experiment XX. (Lesson VI.), and the volume of hydrogen evolved is measured. As 1 litre of hydrogen weighs ·085 g. (approx.), the weight of this volume of hydrogen can be readily calculated. This amount of hydrogen was combined with chlorine in that part of the acid which was decomposed by the zinc, the chlorine now being combined with the latter as zinc chloride.

The contents of the small flask are washed out into a small weighed dish, and evaporated very carefully to dryness, and then weighed. By subtracting the weight of zinc used from that of the zinc chloride obtained, the weight of chlorine which was in combination with the hydrogen is ascertained.

An example will make this clear:—

0·45 g. zinc gave 169 c.c. of hydrogen at 15° C. and 756 mm. pressure.

Since 1000 c.c. hydrogen weigh ·085 g. at the same temperature and pressure, 169 c.c. weigh $\frac{169}{1000} \times ·085 = 0·0144$ g.

Weight of zinc chloride = 0·973 g.

∴ weight of chlorine = ·973 − 0·45 = ·523.

Since ·0144 g. hydrogen were combined with ·523 g. chlorine

∴ 1 g. hydrogen combines with $\frac{·523}{·0144} = 36·3$.

The correct figure is 35·37 and the approximate figure usually employed is 35·5. E. H. T.

HEAT.—X

43. Conduction.—There are three methods by which heat is transferred from hot bodies to cold. One of these, involving the transfer of heated matter, and peculiar to fluids, we have considered, under the name of *convection* (*see page* 342, Vol. i.). The others are no less familiar in everyday experience, and we refer to them as *conduction* and *radiation* respectively.

If we hold an iron poker with one end in the fire, the heat passes down the material of the poker from particle to particle till it reaches the hand: this is the process of conduction; and more or less this process will take place through all substances, though not with equal ease and rapidity. Even in liquids and gases, conduction takes place to some extent, though, of course, convection is in their case the usual process. But convection is the result of moving masses of hot liquid or gas, which carry their heat with them; there is no transfer of matter during conduction; only the heat is conveyed in a manner easy to understand when we think of heat as a form of motion. We can think of it in the simile of a row of soldiers standing shoulder to shoulder in a row. If No. 1 gives a little bump to No. 2, it is the last man in the file who shows the effect of the bump: the motion is conveyed from man to man, as heat in conduction is conveyed from particle to particle of the conducting body.

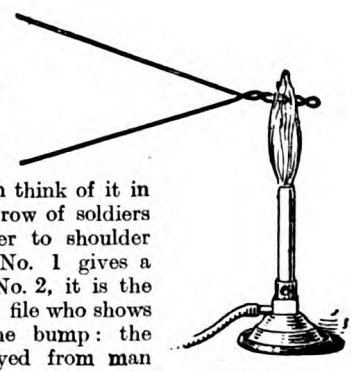


Fig. 57.—Comparing the conductivity of iron and copper.

Many familiar facts remind us that different materials have different conducting power. If a silver spoon be used to stir a cup of hot tea, it quickly becomes too hot to hold and may thus be recognised from a spoon that is merely electro-plated. A piece of wood may be held flaming in the hand until the flame is quite close to the finger, owing to the fact that wood is a poor conductor. Wool strikes warm to the skin because it is a bad conductor and does not carry the heat away quickly. Cotton garments strike cold for the opposite reason. Water is a bad conductor: a layer of turpentine may be burned on the surface of water without causing a substantial rise of temperature in the water at the bottom of the vessel. The spheroidal state of water is due to the bad conducting power of steam, and the admixture of air with substances, as in loose powders, makes them bad conductors also.

In order to illustrate the matter more definitely, several experiments can be tried.

1. Take two wires of equal diameter, but of different metals—e.g., copper and iron; twine one end of each together as indicated in Fig. 57. Coat each wire with a thin layer of wax, by dipping them into the melted wax. Then heat the junction in the flame

and notice that the wax melts farther along the copper than along the iron in an equal time.

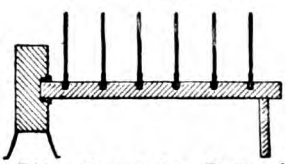
2. In a metal trough several holes are bored to receive equal rods of different materials—e.g. copper, brass, iron, glass, wood. At equal distances from the trough, a small piece of phosphorus is placed on each bar. Boiling water is poured into the trough, and the order in which the pieces of phosphorus take fire indicates the order of the conducting power or *conductivity* of the materials.

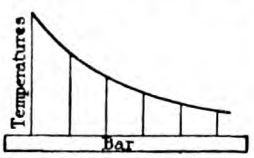
3. Hold a piece of wire gauze an inch above the nozzle of a Bunsen burner. (Fig. 58.) Turn on the gas and light it on the upper side of the gauze. The flame does not pass below the gauze.

4. Wrap a piece of paper tightly round a brass rod, and heat it in the flame. The paper does not take fire. Repeat the experiment with a wooden or glass rod, and the paper does take fire. The good conductor, brass, carries the heat away so rapidly that it cannot light the paper : the wood soon becomes hot enough to ignite it.

Fig. 58.—
A striking experiment.

The action of wire-gauze probably depends on two factors. The iron is a good conductor and conducts the heat away from the immediate neighbourhood of the flame, so that the temperature needed to ignite the gas below is not reached. But possibly the air in the spaces of the gauze, as a bad conductor, also helps to prevent the heat from passing through. This useful property of wire-gauze, at all events, receives a valuable application in the Davy lamp. The flame of the lamp is surrounded with two layers of the gauze, so that insufficient heat passes through to ignite the inflammable fire-damp of the mine.





Figs. 59 and 60.—Determining the distribution of temperature in heated iron and lead.

It should be noted that the rate at which heat passes along a bar does not depend entirely on its conductivity. For example, if equal bars of iron and lead are coated with wax, and one end of each is heated to 100°, as in Exp. 2 (above), it will be found that the wax will melt first on the lead, at points close to the bath, although the iron is the better conductor. This is because the specific heat of the lead is much lower than that of iron ; consequently, the melting-point of wax is reached when much less heat has passed through the lead than the iron. But after a time, a steady condition is reached, when the heat passing along each bar is just enough to supply that which is lost to the air, etc. The metals are then heated to a steady state; at any one point the temperature is constant, and the question of specific heat does not arise. It will then be found that the wax melts farther along the iron than along the lead.

If a series of holes is drilled in these bars so that thermometers can be inserted (Fig. 59), we can read the temperature at various parts of the bar when the steady state is reached, and by plotting a curve, as in Fig. 60, obtain the distribution of temperature in each case.

If we wish to prevent a piece of ice from melting, we wrap it in wool, which is, of course, a bad conductor. Substances can be kept hot in a similar way. But the most efficient protector is a vacuum; this is illustrated in the Thermos flask, which is a double-walled glass vessel with the space between the walls exhausted. In such a vessel, liquid air can be handed about, and liquids can be kept hot a very long time.

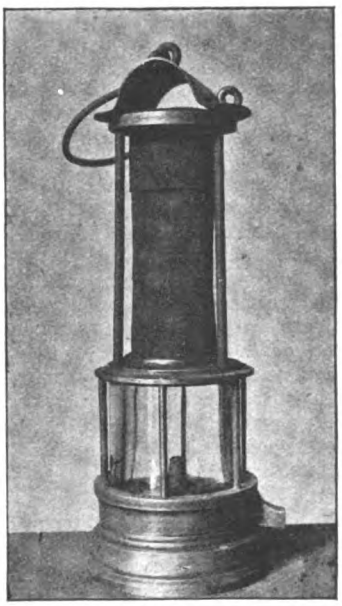
44. Radiation. — When we receive heat, along with light, from the sun, the heat passes over ninety-three million miles of space which contains no matter in the ordinary sense. This method of heat-transfer, which does not depend upon material substance, is spoken of as *radiation*. The presence of matter sometimes does, and sometimes does not, stop the passage of heat by radiation; but even where it does not, the matter is not affected by the radiation, which is carried out by the ether of space.

All bodies which are hotter than their surroundings radiate heat. If we put an iron poker into the fire for two or three minutes, we can feel that it is radiating heat, though it is quite dark. If we keep it in the fire ten minutes it begins to emit a dull red light, as well as the heat; heat it still more and it glows white hot. This simple set of facts suggests to us that radiant heat and light, though they differ in their effect on the eye, are phenomena of the same fundamental nature; and further experiment confirms this suggestion, when it is found that radiant heat obeys the same physical laws of reflexion, refraction, etc., which we shall find to hold good for light. We picture the molecules of a hot body to be in rapid vibratory motion; this motion is communicated to the all-surrounding ether, which we suppose to fill all space and to permeate all matter, and is carried off as a train of waves: these waves constitute the radiation; and when they fall on to a material substance they may communicate their motion to its molecules, and so raise the temperature. The waves themselves are not heat or light, but simply carriers of the energy which constitutes these. The waves of radiant heat are found to differ from those of light in their frequency and in their length, but in no other way. Those waves which arouse in our eye the sensation of sight are those whose length lies between about $\frac{32}{1000000}$ and $\frac{14}{1000000}$ inch. The heat-waves which do not affect vision are longer than the longest of these.

When we speak of radiation, then, we mean the process by which a hot body, like the sun, gives off heat (and light) in the form of waves in the ether, which travel at the speed of light and may be converted into heat, light or other forms of energy under suitable conditions. Confining our attention

to waves of radiant heat only, we note that on striking a material substance these waves may suffer three possible fates:—(1) They may pass through unchanged; (2) they may strike the surface and be *reflected* back; (3) they may be *absorbed*, destroyed as waves, and reappear as heat. These possibilities are most familiar in the case of light-waves. If they go on in an absolute and unmixed manner we get (1) perfectly transparent bodies; (2) perfect reflectors or mirrors; (3) perfectly black substances.

Bodies which allow heat-waves to pass through them are called *diathermanous*, those which will not, *adiathermanous*. Generally speaking, transparent bodies are also diathermanous, and vice versa, but by no means to an equal degree. A block of rock-salt is almost equally transparent to both radiant heat and light; but a solution of alum, or a block of glass, are only imperfectly diathermanous. A solution of iodine in carbon disulphide is practically opaque, but it transmits radiant heat freely. Water-vapour and light mists which are transparent to light cut off a good deal of the heat-waves which accompany the light. It is for this reason that a cloudy night is usually warmer than a clear night: the heat radiated from the earth at night cannot escape so easily. Hence the air near the earth's surface is more cooled on clear nights than on cloudy nights; and in consequence *dew* and *hoar-frost* occur only when the air is clear. So in a hot-house: the glass allows the light-waves to pass freely; they are absorbed by the walls, etc., and radiated again as heat-waves, which are largely stopped by the glass.



A MODIFIED DAVY SAFETY LAMP

in which wire gauze, a very bad conductor of heat, is wrapped round the flame, thus preventing sufficient heat passing through to ignite the fire-damp of the mine.

In order to experiment on these points we need a sensitive detector of radiant heat. We describe briefly three forms of apparatus suitable for this purpose.

Leslie's Differential Thermometer (Fig. 61) is a double air-thermometer, consisting of two bulbs containing air and connected by a bent tube *a b c d*. In the tube is a coloured liquid which, when the

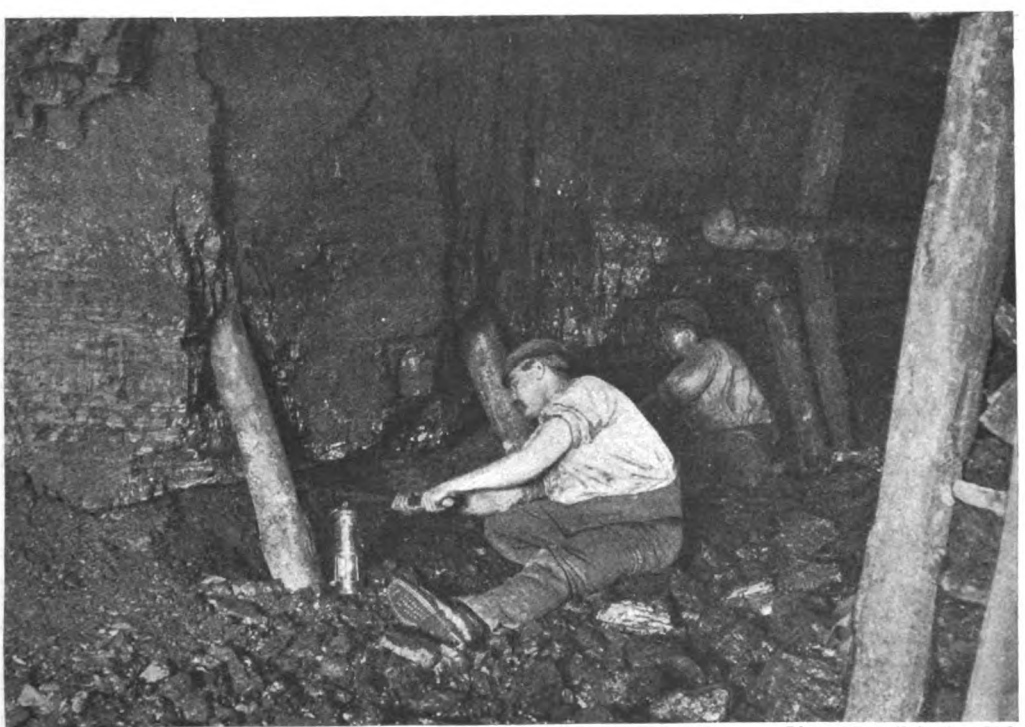


Photo: Cassell & Co., Ltd.

THE DAVY LAMP IN USE,

showing a miner working, with a lamp beside him, on the face of the coal in the Griff Colliery.

two bulbs are at the same temperature, stands at the same level in each arm of the tube. If the temperature of one of the bulbs, say X, is higher than that of the other, the rise of pressure caused in X will push the liquid down to *a*.

The **Thermopile** is an electrical arrangement, so constructed that if heat falls on one of its faces an electric current is sent through the galvanometer. (Fig. 62.) This is on the whole the most convenient arrangement, because the movement of the needle of the galvanometer can easily be measured; it is proportional to the strength of the current, which in its turn is proportional to the difference of temperature between the two faces. The trumpet-shaped cone makes the instrument more sensitive by catching more of the heat. (Fig. 62.)

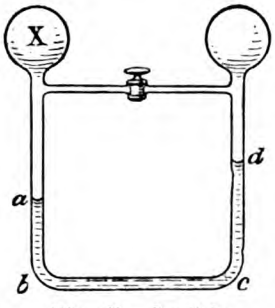


Fig. 61.—Leslie's Differential Thermometer.

The **Radiometer,** invented by Sir W. Crookes, is an exceedingly sensitive detector of radiant energy. It consists of a glass bulb, exhausted of air, in which are four delicately-poised vanes of silver each blackened one side. If a source of heat is placed near the bulb, the vanes rotate rapidly.

As a convenient source of heat, a **Leslie's Cube** may be employed. This is a cube of tin, about 4 inches long, which can be filled with water at any temperature. (Fig. 63.) The four faces of the cube

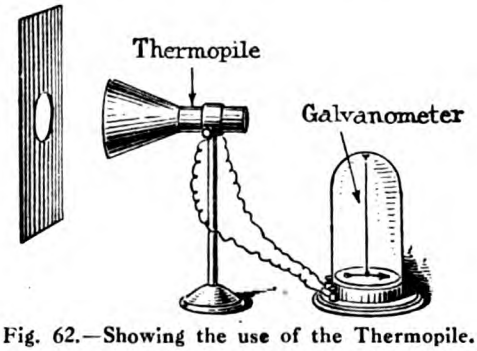


Fig. 62.—Showing the use of the Thermopile.

each have a different surface. One is blackened with lampblack; another is highly-polished; a third is roughened; and the fourth is whitened.

When a more intense radiation is required, as in experiments on diathermancy, a small glow-lamp can be used, or, failing that, a good sperm candle.

In order to compare the diathermancy of different materials, arrange a screen with a hole in it between the source of heat and the thermopile, in such a way that the lamp, the hole and the receiver of the thermopile are in the same straight line. Notice the distance moved by the needle of the galvanometer. Then cover the hole with a piece of glass: the needle shows only about 30% of its former deflection. Hence the glass had stopped about 70% of the radiation. Rock-salt stops less than 10%, and alum solution as much as 96% or more. As all these substances are transparent to light, it is clear that, in the case just supposed, not more than 4% of the radiation emitted by the lamp would produce vision, which shows that it is a very wasteful source of light.

45. Reflexion of Radiant Heat.—If one of the bulbs x is covered with tinfoil, and a hot body placed exactly midway between the two bulbs, the movement of the liquid will show that x is the cooler of the two. This is because the tinfoil is a good reflector and lets none of the heat pass through it. All polished substances are good reflectors, both of heat and light; and the laws of the process are the same for both kinds of radiant energy. These laws it will be most convenient to deal with when we study light. But the fact of reflexion of heat is illustrated in many ways. A silver teapot, for instance, should be polished inside, as well as outside: the heat will then be reflected inwards, and be retained, as is desired.

Fig. 63.—Leslie's Cube.

The rate at which heat is radiated from a hot body depends upon several factors. One of them is the nature of the surface. If we wish to reduce the rate of radiation, we must polish the surface. We do this in calorimeters, and it is an advantage to keep the outside of a silver teapot polished for the same reason. In concise language—*good reflectors are bad radiators.*

The point may be illustrated with Leslie's cube. Fill the cube with warm water and place it with one of its rough faces facing the thermopile. Note the deflection. Then turn the cube round so that the polished face is towards the thermopile, and notice the much-reduced deflection of the galvanometer.

46. Absorption of Radiant Heat.—When heat or light is neither transmitted nor reflected, it must be absorbed. Generally, of course, more or less of each takes place; but a blackened surface is an almost perfect absorber. This can be tested by coating one of the bulbs of a differential thermometer with lampblack, or soot. A source of heat placed midway between the bulbs will warm the blackened one more than the other, because, while there is some reflexion from the glass, there is none from the lampblack. If a black coat is worn in the open sunshine, the effect of this absorption can be felt; it is easily noticed on all dark objects such as grass. The use of the blackened vanes in the radiometer can now be explained. The blackened faces become warmer than the polished faces on the other side. Thus the few molecules of air remaining in the bulb rebound from the blackened faces with greater energy, and cause a more violent recoil. This recoil it is which causes the vanes to move, with the polished faces in front.

As good reflectors are bad radiators, so *good absorbers are good radiators.* If we wish to increase

the rate of radiation of a hot body, we must darken its surface. This fact can well be tested with a Leslie's cube. The radiating or emissive power of a surface can be reduced to exact measurement by taking as standard the emissive power of a surface coated with lampblack. We have only to compare the deflections produced in a thermopile by the two surfaces on a Leslie's cube radiating for an equal time. We can also measure the absorptive power by a simple device, and find that absorptive and emissive powers are very nearly equal for the same surface.

When the sun is shining, the land becomes much hotter than the water, because the latter absorbs practically no heat. Consequently, near the sea, the air above the land becomes hotter than that over the sea. Hence convection currents are set up which result in the development of a *seabreeze* during the day, from the sea to the land. But during the night, the conditions are reversed. The land, being the better radiator, cools faster than the sea; and a *landbreeze* is consequently set up during the night.

If a black spot is made on a piece of platinum foil and the foil heated strongly in the blowpipe, the spot will glow more brightly than the metal. The black material, which is the better absorber when cold, is the better radiator when hot.

47. Cooling.—The rate of cooling of a hot body, i.e. its rate of radiation, is dependent upon its surface primarily, but not wholly. Under ordinary conditions, the cooling of a hot body is greatly hastened by convection currents in the air. Besides this, we have also to notice that the rate of cooling is greater, the greater the difference of temperature between the cooling body and its surroundings. Thus the cooling from 60° to 50° is quicker than the cooling of the same body from 30° to 20°. Moreover, it is the loss of *heat* that is dependent on the nature of the surface: the fall of *temperature* depends on the specific heat of the cooling substance.

E. W. E.

ZOOLOGY.—X

We have now traced the rise of animals above the high-water mark of the marshes, up to the high dry land; a transition effected by new and specialised forms of feet and teeth. Now we come to two orders at the opposite pole, animals which abandoned the struggle for life ashore, took the line of least resistance, and went back to the waters whence originally all life had emerged. We do not here include the seals and their allies, for, as already explained, they are brigaded with the carnivora. They are animals which, while they pass a great part of their lives in the water, come ashore for important periods.

But the sirenia—that is, the manatee and dugong—and the cetacea—the order of whales, have severed all association with terrestrial affairs. Like ships they have gone down to the sea, and occupy their business in great waters. They could not if they would return to shore. Yet every whale, dolphin, porpoise, manatee and dugong is the descendant of animals which were as completely terrestrial as present-day cattle. The sirenia have been traced back to an ancestry more or less closely allied to that of the elephants and the puny hyraxes. The whales evolved, science declares, in Mediterranean Africa from those extremely primitive land carnivora, the creodonts.

Water-dwelling Mammals

The first mammals, earlier than the ancestors of the present group, were no larger than rats, yet we have sirenia (the extinct Steller's sea-cow) 20 feet in length, among their posterity, and whales of 80 to 100 feet and more. The assertion that these monsters of the deep can have sprung from an ancestry so contemptible in respect of bulk seems absurd. But successive generations of scientists have delved and dug and pieced together the amazing record of the rocks, and it is as certain that whales number the very minutiæ of mammals among their related predecessors as that the nightingale descends from a far forgotten reptile.

It was in the great age of reptiles that the first warm-blooded animals began to emerge. The reptilian monsters had possessed the earth and waxed titanic in all but brain. The time had come for a trial with a new type, and the belief is generally held that it was of advantage to the first of mammals to be small and inconspicuous, so that they might escape the attention of the giants whose food was flesh.

The new and higher type was small, but with the potentiality for physical and mental development. They, like their cold-blooded predecessor, and like the birds, which arose in much the same era, did not escape the general tendency towards giantism. That is to say, side-branches blundered on into impossible bulk, while the lesser more generalised survived. The elephant on land, with the whales in the sea, alone remain to attest in the flesh that the evidence of the geological strata is accurate—that monsters did arise in every phase of life. They demonstrate that with the original impulse to excessive growth apparently not wholly exhausted, and with food supply sufficing and environment still favouring, they can yet retain their place in the scheme of living things.

In the mighty hurly-burly, in the rise of new types and the overthrow of others,

many moulds were employed by Nature, many media exploited. There were the swamps for the reptiles and semi-aquatic animals. There were the plains and the savannahs for the ungulates, the air and the trees for the birds, lake and stream and river for fish and bird and mammalian life. Finally there remained the sea, in which fish armed themselves with bony plates, but from which the giant ichthyosaurs and plesiosaurs had vanished.

Whales and Sirenia

There indeed lay the greatest sphere for development if any land animal could adapt itself to the conditions. We have seen how the fin-footed animals fitted themselves for seafaring. They, however, have not gone as far as the whales and the sirenia. These are as highly specialised animals as any the world reveals. Specialisation, it must again be noted, does not invariably connote enduring progress; it may lead, as it so often has, to degeneration and extinction.

Genus after genus of sirenia has perished, one at the hands of unsparing man, others, many, many others, by slow natural elimination. Many whale-like forms are numbered with vanished ancestors of other surviving orders. The sirenia and the whales have sacrificed almost every feature associating them with locomotion on the land. The manatees and dugongs have entirely relinquished external evidence of hind limbs; the whales retain only vestigial bones of what were formerly hind legs and pelvis. The baleen whales, those which yield what we term whalebone, have sacrificed their teeth, as well as their hind limbs.

Yet we know that they once possessed normal mammalian dentition, for in the unborn whale there are two sets of teeth in the gums, one the milk teeth, the other which, if developed, would be the permanent teeth; but these are absorbed before birth, just as the jaws of human beings absorb bone into the blood after a tooth has been extracted.

All mammals have hair; they have the heart and lungs strongly partitioned off from the abdominal cavity by means of a diaphragm. But how is this to be applied to the sea-cows and the whales? it will be asked, seeing that both forms are smooth and hairless. They are not actually hairless. Hairy, bristle-like appendages still appear about the mouth of both whales and sirenia. Indeed in the latter the young before birth are hair-clad, and we know that when sirenia first took to the water they were, like seals, clothed with a coat of hair. Some of them still retain hair upon the under side of the flippers, useful to them, we suppose, in maintaining a grip on the slippery watergrowths upon which they feed; as hair is useful upon the paws of polar bears to secure a grip upon the ice, and hair upon the under sides of the hoofs of reindeer and yak in affording those animals a similar foothold.

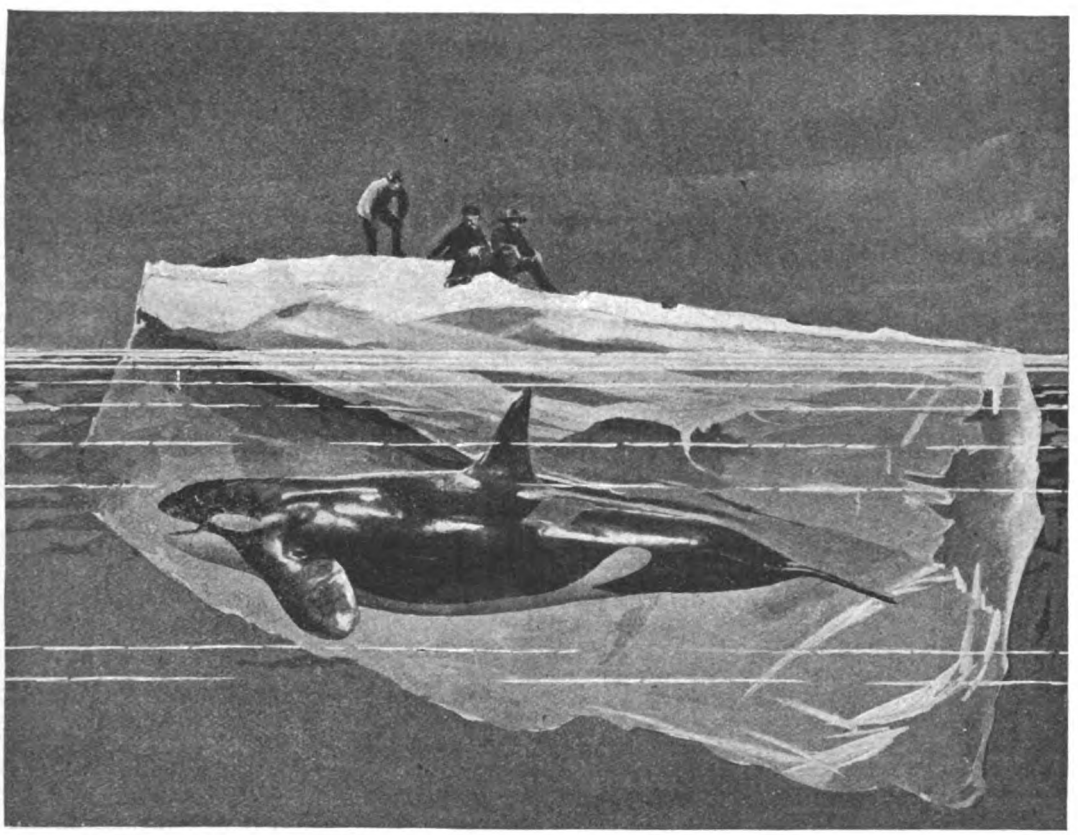
The members of these two orders, in order to swim the waters, have approximated, to a certain extent, to the contour and characters of fishes, but they remain typical mammals. In the course of these pages we have noted several examples of parallel design in Nature. We may note another at this point. As it is given to camels and giraffes automatically to seal their nostrils against the dust of the sandstorm, and to the hippopotamus to close its nose and ears against the water, so the members of this order are protected against flooding of their internal organs by like devices. But in the whales the safeguard is effected by a union of windpipe and nostrils, without any opening into the mouth, hence water cannot enter the lungs.

Needless to say they breathe atmospheric air as we do. If the reader of these lines should be affronted by the reminder he may be certain that in any average company he will find whales, dolphins or porpoises, one or all of them, described as fishes. Even as to the great whale itself, there is still a laughable uncertainty; and our elders who still preserve their Johnson's Dictionary will turn up the entry in that redoubtable volume and point to the line, "Whale: The largest of fishes"!

Twelve hours under water

When whales and sirenia elected to make the sea their homes they could not so alter their physical organisation as to substitute gills for lungs. They could not breathe air in solution, but must come up to the surface to inhale the open air. But they have so modified their respiratory system that they can remain submerged, the sirenia for ten minutes or so at a time; the great baleen whales for still longer, and the rorquals, it is said, for twelve hours at a stretch. This immense advantage arises from the fact that the animals of these two orders conserve oxygen in their blood as the camel conserves water in the cells of its stomach. It is even suggested that the rorqual, whose long continuance

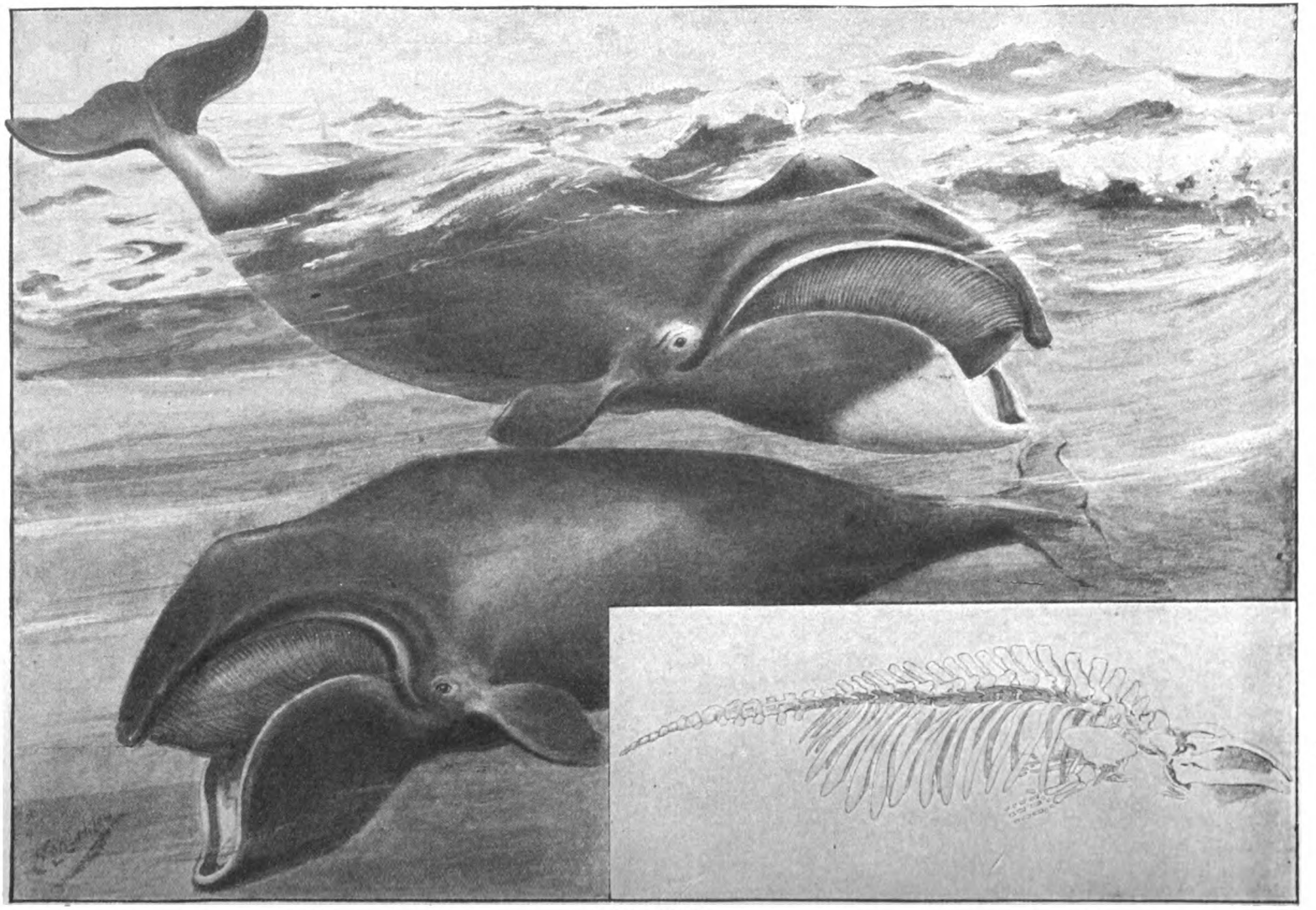
under water rivals the early submarines, derives aid from dermal respiration, absorbing oxygen from the water by means of massive longitudinal folds of skin beneath the lower jaw. These folds of epidermis are thought to act almost after the fashion of the gills of fishes. Upon that we have no positive evidence, but the theory deserves exploration, for so many changes which we might have thought impossible have been wrought in the water-dwelling mammals that even this wonder is not wholly incredible.



THE KILLER WHALE OR GRAMPUS

is the fiercest carnivorous monster of the deep, fiercer than the shark; it proved a constant menace to members of the Shackleton Antarctic Expedition, who were frequently attacked while stranded on ice-floes.

Who, if the facts were not before us, a sort of miraculous commonplace, would believe that the mouth of the whalebone whale could be transformed from a generalised carnivorous mammalian type into the vast dredge which it becomes in reality? The whalebone which fills the mighty mouth of the baleen whale consists of between 300 and 400 horny plates, fringed along the surfaces which extend into the centre of the mouth; an incomparable apparatus for the manner of food-capture practised by the beasts. Now these plates are simply modifications of the ridges on the palate which we find in the mouth of the ungulate, and find, moreover, rising on our own palates. When the mouth is closed these plates lie flat, parallel with the palate, the frontal series folding back on top of the hindmost. When the mouth is opened, the plates spring forward automatically, and assume a vertical position. The same principle brings the fangs of the snake into operation. As the reptile closes its mouth, the fangs depart from their vertical position and lie parallel with the jaw, but when the mouth is opened they are simultaneously erected and are ready to bite. The baleen whale does not bite. It ships a sea, as it were, raises its colossal tongue towards the roof of its mouth, so forcing the water out through the fringed plates. The water runs out "strained," but all that it con-



1.

2.

3.

BALÆNAS.

1. *Balæna mysticatus*, the Greenland Whale. 2. *B. Australis*, the Cape Whale. 3. Osteology of *Neobalæna marginata*, the Pigmy Whale. The baleen is not really a herbivore; its food consists of hosts upon hosts of pteropods and tiny crustaceans.

tained in the form of solids is retained in the dredge, and falls upon the tongue, whence it passes down the monster's minute throat.

The problem of Jonah and the whale naturally comes to mind in this connection. Assuredly he was not engulfed by a " right " whale or its baleen-bearing kin, for the throat is so small that nothing larger than a sprat would pass it. The great sperm whales would, however, swallow a man without much effort. So would the fierce insatiable orcas or killers, grampuses as we call them. These latter have been found when killed and examined to contain enormous quantities of food, large seals and porpoises, whole. One grampus, which measured 21 feet, was discovered to have swallowed thirteen porpoises, and fourteen seals ! Grampuses were the chief of living terrors to Sir Ernest Shackleton and his men in his Antarctic expeditions, for when men were stranded on ice-floes the ravenous beasts pursued them and, charging at their floating platforms, endeavoured to overset the latter in order to get at the men.

Wolves of the Sea

We call the shark the tiger of the deep, but the activity and ferocity of the grampus render it really more to be feared than the fish with the worst of reputations. The grampus is possibly the only natural enemy of the great Greenland whale. A school of killers, attacking one of these monsters, has been likened to a pack of wolves or hounds holding a stricken deer at bay. They devour it piecemeal, concentrating upon the head and ripping great masses of flesh from the bleeding lower lip, until the mouth is opened, when they dart in and tear the prodigious tongue to pieces. So, if the great baleen whales began their careers as terrestrial carnivore, then passed, like the ungulates, to a more innocent diet, the squid-eating sperm whales and the grampuses remained true to tradition.

But the baleen whale is not really a herbivore. His food is minute, simply hosts upon hosts of pteropods and tiny crustaceans, and flesh is therefore the diet of these greatest of animals. There is almost no limit to the food supply, there is no appreciable limit to the sea and means of transport ; there is and has been, every element present inducing huge development, and the modern whale is the result. The fact that dolphins and porpoises, though very highly specialised, have not attained the like gigantic proportions is in keeping with all that we have observed of other orders, where various genera, proceeding from the one ancestral line, have shown the same disparity in bulk, and corresponding differences in outline.

Similarly we trace a corresponding variation of habit in the two orders forming the subject of the present chapter. In the manatees, which are natives of West Indian, South American and African waters, we have a mainly estuarian and riverine type which, though it frequents shallow inshore waters, takes less boldly to the sea than the dugong. The dugong itself is not a free rover like the cetacea, preferring shore waters and shallows, but it never ascends rivers, and feeds exclusively upon weeds furnished by the sea. Much as manatees and dugongs resemble each other there are manifest differences between the two genera. The manatee has the tail less whale-like than the dugong. It possesses a unique cleft upper lip, the which acts as an organ of prehension. The extremities of the divided lip are developed into two fleshy pads, which can be brought close together or kept wide apart. Thus by bringing the two sections of the lip into opposition with each other, the manatee can grasp food.

The lip of the dugong has been specialised beyond that stage, for the cleft, of which vestigial evidences remain, has almost lost its identity, and all power of grasping with the lip is gone. As has been noted, the sirenia have no hind limbs, but in an extinct species, the halitherium, there was a pelvis distinctly resembling that of the rorqual whale.

Blubber and Oil

Blubber is present beneath the thick coarse hide of the sirenia as in the whales, but whereas the latter contain much free oil, there is none in the sirenia. The whales have undergone much more degenerate specialisation in the matter of skeleton than the sirenia, in which the bones are still stout and massive and solid, whereas in the other order they become increasingly spongy and permeated with oil, and the ribs have but indifferent attachment to the spine.

One great curiosity of the manatee is that it possesses only six vertebræ in the neck. This is quite exceptional in mammals, where seven vertebræ compose the neck, from giraffe to jerboa. The whale has no externally perceptible neck, but the remnants persist, hidden within the flesh behind the great head. Though the length of this hidden neck may be no more than a dozen

inches, there are the seven vertebræ, as obvious as the seven enormously elongated vertebræ in the neck of the giraffe.

All these animals are warm-blooded, give birth to living young, and nurture these upon milk, suckling them precisely as any land mammal suckles its young. It is believed that the dugong is responsible for the mermaid legend. In feeding its little one it rises to the surface of the water and holds it to its breast with one of its flippers. Dam and offspring are round-headed, and at a distance undoubtedly present a likeness to human figures in the water. Ancient mariners clearly mistook them for sea humans. The fish-like tail, revealed as the dugong turned to dive, would furnish the belief as to the pisciform lower quarters of these supposed deities of the deep.

Tail Propellers

There are a thousand and one examples in these two orders of the possibilities in evolution, and we have cited but a few outstanding. From flesh-eating animals of moderate size we progress to animals in which the fore-legs and feet become paddle-shaped, and advance to animals in which the same organs disappear completely in a mass of flesh and skin to form true flippers, balancing organs, we suppose, for the whale falls upon its side when injury incapacitates the flippers. The hind legs go, and a great flat tail becomes the means of locomotion.

The whale when travelling at speed uses its tail for vigorous up and down motion, so far as can be seen ; but when it is moving slowly the tail is employed in such a manner that its movement produces an effect precisely like that of the screw propeller of a steamship.

From torrid Mediterranean Africa the whales took to waters by which they could invade the poles, or course in heat and comfort through the steaming surface waters of the tropical regions. There temperature does not vary. We have in the whales a marvellous living mechanism which is impervious to pressure, insensible to its removal, animals which, feeding or blowing upon the surface at one moment, can in a twinkling descend into the very abysses, miles down, whale hunters say, and yet experience neither hurt nor inconvenience. The whales and sirenia are clearly degenerate in their high specialisation, but their degeneration is certainly the most picturesque and almost incredible degeneration in the world. E. A. B.

ASTRONOMY.—XI

THE Nautical Almanac is an indispensable book. Everyone has heard of it ; few ever see it. The few exceptions are the astronomers. For the subsidiary title of the work is "The Astronomical Ephemeris," and the greater part of it is really intended more for the astronomer and the surveyor than for the navigator.

The Nautical Almanac has a blue paper cover and is about an inch and a quarter thick. Inside it is as full of figures as Bradshaw, with an introduction and a chapter of explanations that are exceedingly stiff and dry.

It contains none of the usual information about the stirring events that belong historically to each day as it comes round, and it does not even give the time of sunrise and sunset. It gives one more day to each month than any other almanac, and an additional day, January 0, also makes its appearance from time to time. It gives the place of the sun and moon and planets as seen from the centre of the earth. It is, in fact, an almanac very far removed from the common kind of almanac. Its calculation every year occupies the time and energies of a most eminent mathematician as director, with a staff of assistants who work in an office in Verulam Buildings, Grays Inn ; and it is published by Order of the Lords Commissioners of the Admiralty.

The Nautical Almanac

Each one of these features has a significance which is easily explained, and which, when apprehended, helps us to understand the very peculiar importance of the Nautical Almanac. The enormous number of figures is easily explained when we remember that the purpose of the Almanac is to enable the navigator or the astronomer to calculate in a minute or two the exact place in the sky of the sun, and the moon, of all the greater and some of the smaller planets, and of some six or seven hundred of the more important stars, for any second of day or night throughout the year, in whatever part of the earth he may happen to be.

The Almanac does not give the time of sunrise and sunset, because that varies very much in different parts of the earth ; but what it does give is the material, the place of the sun, from which sunrises and sunsets can very easily be calculated for any place on earth. The extra day for every month is introduced in order to help in the process known as "interpolation."

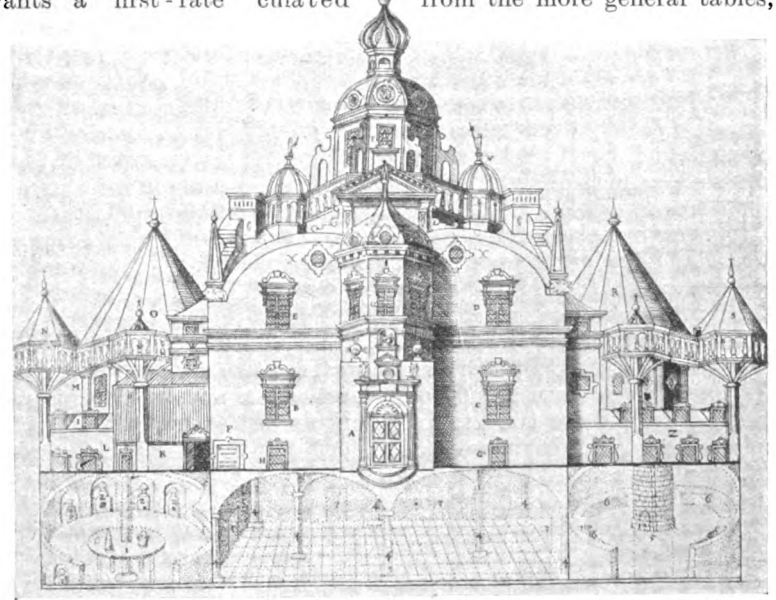
The Nautical Almanac gives the places of the sun and moon as seen from the centre of the Earth, for the same reason that it does not give the times of sunset, namely, because the Almanac is intended for worldwide use; and the centre of the earth is the most convenient point from which to reckon, if all the places on its surface are to have a fair field and no favour. It is published by the Admiralty because the information that it contains is essential to the navigation of His Majesty's ships, and to the operations of charting the seas that go on continually; and it wants a first-rate mathematician with a staff of skilled calculators to produce it, because the figures that it contains are the last stage in the most marvellously complex and difficult enterprise that the brain of man has ever undertaken: the prediction for years in advance of the infinitely intricate motions of the heavenly bodies.

This power of prediction with almost any desired degree of accuracy for years in advance, is the most justly admired and the least understood of all the curious powers that the astronomer is known to possess. The reputation of his science rests upon this power, so striking and incomprehensible to the non-astronomer. Let us look for a few minutes at the basis of the power, and see how it is exercised.

It did not need very much observation to show the astronomers of old that the motions of the sun and the moon and the planets are exceedingly complicated. The sun himself, who so clearly controls the year, does not come back exactly to the same place in the sky on the same day in different years. The moon moves much more quickly in the sky, and very much more irregularly; but still the moon does go more or less straight ahead, and never seems to go backwards among the stars as the planets do.

The stars themselves, the so-called fixed stars, do not form the changeless background on which the motions of the moon and the planets may be securely traced: they shift by slow degrees in a very complicated way, with respect to the pole of the sky. And all these motions have to be first observed and measured, then analysed and disentangled one from another, then reduced to a mathematical theory which has been constructed on a basis of pure dynamics and made to fit them.

After this the theory has to be boiled down into the form of tables that will serve in a general way for many years; and finally, the precise details for any year and for any moment of that year have to be calculated from the more general tables, and put into shape so that they can be ready to hand at any moment when the practical man wants to use them in finding the place of a ship at sea, or fixing a point and true direction for his survey upon land. That is the last stage which it is the business of the Nautical Almanac to perform.



From an old engraving.

The magnificent observatory built by Tycho Brahe in 1576 at Uranienborg, on the island of Hven.

And this service is indispensable. It would be as much beyond the power of most working astronomers as it would be impossible for the navigating lieutenant of one of His Majesty's ships to calculate for himself the place of the sun or the moon whenever he happened to want it. In the first place, he would not have the time; and, in the second place, he would most likely not have the special knowledge required to carry out the process, involving immensely long calculations. He would certainly make a mistake somewhere, which would be fatal.

In any case, it would be grossly uneconomical to calculate a single place of the sun or moon which happened to be wanted at a particular time, just as it would be extravagant to set up a whole factory of machine tools in adjustment in order to make one bicycle or car. When the machines are in order and arranged for the job, it is more profitable to set them to work on a batch of a hundred or a thousand; and so with the Nautical Almanac, it is more profitable and vastly more certain to get the machinery in order for turning out regularly all these tables that the astronomer and the navigator will require for his year's work.

Law of Gravitation

The Nautical Almanac represents, then, the last step in a process which has been going on without intermission ever since the beginnings of modern observational astronomy—ever since Tycho Brahe built his magnificent observatory on the island of Hven. Before the days of telescopes; before there was any idea of the natural laws which govern the motions of the heavenly bodies, Tycho Brahe had seized the great and true principle that the only way to understand how things happen is to observe them closely and continuously; and for two centuries and more it has been the business of some of the principal observatories of the world, especially the national observatories, to observe continually the places of the sun and the moon, the planets and the brighter stars, in order that from time to time there may be a general stocktaking: a comparison of the predictions with the facts, leading to an overhaul of the theory on which the predictions are based, and thus to ever-increasing accuracy.

But we must glance for a moment at the kind of problem which astronomers set themselves, when they try to find a theory for the motions of the sun and moon and planets. The great discovery of Newton, that each particle of matter in the universe attracts each other particle with a force, called the force of gravitation, proportional to the product of the masses of the two particles, and to the inverse of the square of the distance between them, is the starting point in the whole theory. But at first sight it might seem to be very difficult of application.

If one had to treat separately each particle of the sun and of the earth, how would one ever finish the calculation of the mutual effects of the earth and the sun, the one on the other? Happily, it is possible to show that a great simplification is permissible when a body is spherical; it attracts as if its whole mass were concentrated at the centre, and so, instead of taking each particle separately, it is possible to treat the earth and the sun as if they were two single particles of immense mass, occupying mere points.

With this simplification it is not very hard to prove that the motion of one mass about the other must be one of the curves known as conic sections; that is to say, either a circle, an ellipse, a parabola, or an hyperbola. In point of fact, the curve in which the earth does move round the sun is an ellipse—or, rather, it would be an ellipse if it were the only body beside the sun in the whole universe.

Now it may be useful to draw an ellipse. The easiest way to do so is to stick two pins into a sheet of paper on a drawing-board and put a loop of fine string over them. Then if the point of the pencil be put in the loop and guided round by keeping the loop pulled tight against the pins, the resulting curve will be an ellipse, as in the figure (p. 149). The points where the pins are stuck in are the two foci of the ellipse.

Elliptical Curves

A few experiments will show that the nearer the pins are together, the more the ellipse will look like a circle. If the two pins could be merged into one, it would actually become a circle, with the pins at the centre. On the other hand, if the loop of string is only just big enough to go over the pins, the curve will become very narrow compared with its length, and will eventually become a straight line joining the two pins, if the fit of the loop is absolutely a tight fit and the string does not stretch in the least, conditions which cannot be realised in practice.

However, we do not want such very narrow ellipses in astronomy, for the curves in which the earth and the planets move are ellipses very nearly circular, having the two foci very close together. The centre of the sun—or, more precisely, the centre of gravity of the sun and the earth—is in one focus, while the other is empty. If the question is asked, In which focus is the sun? The only answer is that given by a famous professor of astronomy, "In the right-hand one, madam."

Now all this theory is really very simple, were there only two bodies to be considered—the sun and the earth. And the same would be true if there were only the sun and Jupiter, or the sun and any one other planet. There are, however, eight large planets, and several moons big and heavy enough to rank as planets, besides great

numbers of smaller planets whose mass is in the aggregate very far from being altogether negligible. The problem which would have been so simple becomes then infinitely complicated. For every particle of mass in each of these bodies is attracting each other particle of mass. And though we can treat each body as if it were condensed at its centre, still there are at any rate nine bodies to deal with, not counting the moons.

Mathematical Difficulties

We have said that the case of two bodies is simple. The mathematics required to deal with it is certainly more difficult than can be dealt with in a strictly elementary book, but all the same, it is simple mathematics, which should present no difficulty to anyone, let us say, who is leaving school and going up for a mathematical scholarship at one of the Universities. Directly, however, a third body is introduced, the problem immediately becomes the celebrated problem of three bodies, which is so difficult that it has never yet received an exact solution. On the contrary, it has been proved that no complete solution exists in terms of any known mathematical language. And if this is true for three bodies, how much more is it true for a greater number.

An exact solution of the problem of three or more bodies is impossible; but that does not necessarily mean that the problem cannot be solved for practical purposes, with almost any desired degree of precision. It can be, and is solved in the tables of the motion of the planets and the moon, which are the outcome of the planetary and lunar theories. Successive generations of mathematicians have discovered ways of arriving at the desired results, which are not perfect, but which serve well enough for a good many years at a time, though they need occasionally to be adjusted to fit the observed facts.

It is the business of the Nautical Almanac to make all these calculations, and to publish them in the form of tables ready for use. It is all a very complicated business, and, as we have seen, it is founded upon mathematical investigations of the most extreme difficulty. But it is interesting to note that the actual work of calculation is not of extreme difficulty. Provided that there is a man at the head of affairs who thoroughly understands the whole theory of the thing, and is able to judge exactly what process is required to give results of the desired accuracy, the actual work of calculation can be arranged in such a form that it can be done without understanding the theory of it, just as a navigator performs in the ordinary course of his day's work a number of operations and calculations that he does not in the least understand the theory of, but which he is taught to perform accurately by rule.

This is a truth which is of great practical importance, that it is comparatively easy to learn to make use of quite complicated mathematical processes without the necessity for really understanding what one is doing. And as there is a good deal of misconception on the matter, it may be worth while to consider it a little more closely, especially as there is a tendency among those who have arrived at a certain rather elementary degree of knowledge to take up what they conceive to be the superior position, scorning to use a method they do not understand.

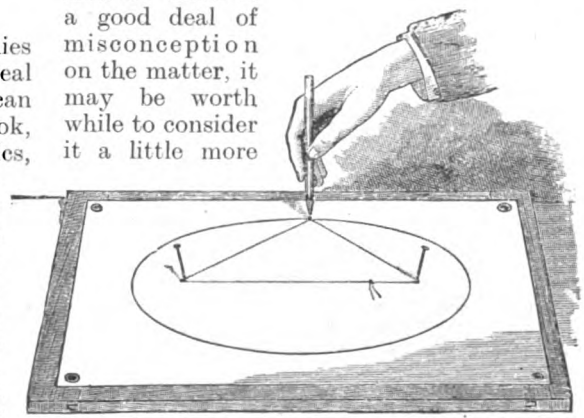


Diagram showing how to draw an ellipse with the aid of two pins and a piece of string.

Practice without Theory

Let it be granted at once that no effort to understand the theory of the thing is thrown away. The man who understands the whole theory is in the strong position that he may be able to make improvement in the practice of it, just as a man who understands all about the optics of a microscope may be able to improve on the standard methods of construction. But there is no reason at all why a man who does not understand optics should not learn to use the microscope with efficiency; and similarly, it is perfectly possible for a man who does not understand the theory of logarithms and of spherical trigonometry to make use of them as tools with complete success, and, indeed, to acquire by constant practice a much greater readiness in their use than the mathematician.

Therefore, do not let anyone be afraid of trying to learn the use of the Nautical Almanac because he is not competent to understand how it is made. A. R. H.

Continued from page 98

LANGUAGES:

Contributors:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A.[Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).

LATIN.—XI

FOURTH OR I-CONJUGATION

EXAMPLE.—**audĭŏr, audītŭs sum, audīrī,** *to be heard.*

Indicative Mood

PRESENT	IMPERFECT
Sing.	*Sing.*
aud-**ĭŏr**, *I am heard.*	aud-**ĭēbăr**, *I was being heard.*
aud-**īrĭs**, *thou art heard.*	aud-**ĭēbārĭs** or aud-**ĭēbārĕ**, *thou wast being heard.*
aud-**ītŭr**, *he is heard.*	aud-**ĭēbātŭr**, *he was being heard.*
Plur.	*Plur.*
aud-**ĭmŭr**, *we are heard.*	aud-**ĭēbāmŭr**, *we were being heard.*
aud-**ĭmĭnī**, *ye are heard.*	aud-**ĭēbāmĭnī**, *ye were being heard.*
aud-**ĭuntŭr**, *they are heard.*	aud-**ĭēbantŭr**, *they were being heard.*

FUTURE	PERFECT
Sing.	*Sing.*
aud-**ĭăr**, *I shall be heard.*	audīt-**ŭs** sum, *I have been* or *was heard.*
aud-**ĭērĭs** or aud-**ĭērĕ**, *thou wilt be heard.*	audīt-**ŭs** ĕs, *thou hast been* or *wast heard.*
aud-**ĭētŭr**, *he will be heard.*	audīt-**ŭs** est, *he has been* or *was heard.*
FUTURE	PERFECT
Plur.	*Plur.*
aud-**ĭēmŭr**, *we shall be heard.*	audīt-**ī** sŭmŭs, *we have been* or *were heard.*
aud-**ĭēmĭnī**, *you will be heard.*	audīt-**ī** estĭs, *ye have been* or *were heard.*
aud-**ĭentŭr**, *they will be heard.*	audīt-**ī** sunt, *they have been* or *were heard.*

PLUPERFECT	FUTURE PERFECT
Sing.	*Sing.*
audīt-**ŭs** eram, *I had been heard.*	audīt-**ŭs** ĕrō, *I shall have been heard.*
audīt-**ŭs** ĕrās, *thou hast been heard.*	audīt-**ŭs** ĕrĭs, *thou wilt have been heard.*
audīt-**ŭs** ĕrăt, *he had been heard.*	audīt-**ŭs** ĕrĭt, *he will have been heard.*
Plur.	*Plur.*
audīt-**ī** ĕrāmŭs, *we had been heard.*	audīt-**ī** ĕrĭmŭs, *we shall have been heard.*
audīt-**ī** ĕrātĭs, *ye had been heard.*	audīt-**ī** ĕrĭtĭs, *ye will have been heard.*
audīt-**ī** ĕrant, *they had been heard.*	audīt-**ī** ĕrunt, *they will have been heard.*

Subjunctive Mood

PRESENT	IMPERFECT
Sing.	*Sing.*
aud-**ĭăr**, *I may be heard.*	aud-**īrĕr**, *I might be heard.*
aud-**ĭārĭs** or aud-**ĭārĕ**, *thou mayst be heard.*	aud-**īrērĭs** or aud-**īrērĕ**, *thou mightst be heard.*
aud-**ĭātŭr**, *he may be heard.*	aud-**īrētŭr**, *he might be heard.*
Plur.	*Plur.*
aud-**ĭāmŭr**, *we may be heard.*	aud-**īrēmŭr**, *we might be heard.*
aud-**ĭāmĭnī**, *ye may be heard.*	aud-**īrēmĭnī**, *ye might be heard.*
aud-**ĭantŭr**, *they may be heard.*	aud-**īrentŭr**, *they might be heard.*

PERFECT	PLUPERFECT
Sing.	*Sing.*
audīt-**ŭs** sim, *I may have been heard.*	audīt-**ŭs** essem, *I might have been heard.*
audīt-**ŭs** sīs, *thou mayst have been heard.*	audīt-**ŭs** essēs, *thou mightst have been heard.*
audīt-**ŭs** sĭt, *he may have been heard.*	audīt-**ŭs** essĕt, *he might have been heard.*
Plur.	*Plur.*
audīt-**ī** sīmŭs, *we may have been heard.*	audīt-**ī** essēmŭs, *we might have been heard.*
audīt-**ī** sītĭs, *ye may have been heard.*	audīt-**ī** essētĭs, *ye might have been heard.*
audīt-**ī** sint, *they may have been heard.*	audīt-**ī** essent, *they might have been heard.*

Imperative Mood

PRESENT	FUTURE
Sing.	*Sing.*
aud-**īrĕ**, *be thou heard.*	aud-**ītŏr**, *thou shalt be heard.*
	aud-**ītŏr**, *let him be heard.*
Plur.	*Plur.*
aud-**ĭmĭnī**, *be ye heard.*	aud-**ĭuntŏr**, *let them be heard.*

Infinitive Mood

PRESENT	PERFECT
aud-**īrī**, *to be heard.*	audit-**ŭs** essĕ, *to have been heard.*

FUTURE

audīt-**um** īrī, *to be about to be heard.*

Participles

PERFECT	GERUNDIVE
audīt-**ŭs, -ă, -um**, *heard* or *having been heard.*	aud-**iendŭs, -iendă, -iendum**, *fit to be heard.*

The learner should notice that the first person singular passive of any tense formed from the present base may be found by adding **-r** to the active, or substituting **r** for the final **m** if such exists. The forms of the imperfect subjunctive in the passive voice may be found by adding the endings of person and number **-r**, **-rĭs** or **-rĕ**, **-tŭr**, **-mŭr**, **-mĭnī**, **-nt** to the present infinitive active. Except in the present indicative, where its occurrence is very rare, the forms for the second person singular passive ending in **-rĕ** are used much oftener than those ending in **-rĭs**. In the present indicative this form might be mistaken for the present infinitive active.

Note the importance of observing the marks of quantity in distinguishing between such parts as the present infinitive active, e.g. **lĕgĕrĕ**, *to read*, and the future indicative passive, e.g. **lĕgērĕ**, *thou wilt be read.*

Write out the passive conjugations of the following verbs, of which the first person singular of the perfect tense and the accusative supine are given, with the number of their respective conjugation :—**dēfendō**, **-dī**, **-sum**, 3, *to defend ;* **dēfīnīō**, **-īvī**, **-ītum**, 4, *to limit, to mark out ;* **dēlĭbĕrō**, **-āvī**, **-ātum**, 1, *to deliberate ;* **incendō**, **-dī**, **-sum**, 3, *to set fire to, to burn ;* **instrŭō**, **-xī**, **-ctum**, 3, *to construct, to draw up ;* **mūnĭō**, **-īvī** (or **-iī**), **ītum**, 4, *to fortify ;* **pŭtō**, **-āvī**, **-ātum**, 1, *to prune, to think ;* **vĭdĕō**, **-vīdī**, **vīsum**, 2, *to see.*

Synopsis of the Four Conjugations

Active Voice

Indicative Mood

PRESENT

	Sing.	*Plur.*
1.	ăm-, -ō, -ās, -ăt	-āmŭs, -ātĭs, -ant
2.	mŏn-, -ĕō, -ēs, -ĕt	-ēmŭs, -ētĭs, ent
3.	lĕg-, -ō, -ĭs, -ĭt	-ĭmŭs, ītĭs, unt
4.	aud-, -ĭō, -ĭs, -ĭt	-ĭmŭs, ītĭs, -iunt

IMPERFECT

1. ămā-
2. monē-
3. lĕgē-
4. audīē-

-bam, -bās, -băt, -bāmŭs, -bātĭs, -bant

FUTURE

1. ămā-
2. mŏnē

-bō, bĭs, -bĭt, -bĭmŭs, -bĭtĭs, -bunt

3. lĕg-
4. audĭ-

-am, -ēs, ĕt, -ēmŭs, -ētĭs, -ent

PERFECT

1. ămāv-
2. mŏnŭ-
3. lēg-
4. audīv-

-ī, -istī, -ĭt, -ĭmŭs, -istĭs, -ērunt or ērĕ

PLUPERFECT

1. ămāv-
2. mŏnŭ-
3. lēg-
4. audīv-

-ĕram, -ĕrās, -ĕrăt, -ĕrāmŭs, -ĕrātĭs, -ĕrant

FUTURE PERFECT

1. ămāv-
2. mŏnŭ-
3. lēg-
4. audīv-

-ĕrō, -ĕrĭs, -ĕrĭt, -ĕrĭmŭs, -ĕrĭtĭs, -ĕrint

Subjunctive Mood

PRESENT

	Sing.	*Plur.*
1.	ăm- -em, -ēs, -ĕt,	-ēmŭs, -ētĭs, -ent
2.	mŏne-	
3.	lĕg-	-am, -ās, -ăt, -āmŭs, -ātĭs, -ant
4.	aud-	

IMPERFECT

1. ămā-
2. mŏnē-
3. lĕgĕ-
4. audī-

-rem, -rēs, -rĕt, -rēmŭs, -rētĭs, -rent

PERFECT

1. ămāv-
2. mŏnŭ-
3. lēg-
4. audīv-

-ĕrim, -ĕrĭs, -ĕrĭt, -ĕrĭmŭs, -ĕrĭtĭs, -erint

PLUPERFECT

1. ămāv-
2. mŏnŭ-
3. lēg-
4. audīv-

-issem, -issēs, -issĕt, -issēmŭs, -issētĭs, -issent

Imperative Mood

	Present.	*Future.*
1.	ăm-ā, -ātĕ	-ātō, -ātō, -ātōtĕ, -anto
2.	mŏnē, -ētĕ	-ētō, -ētō, -ētōtĕ, -entō
3.	lĕg-ĕ, -ĭtĕ	-ĭtō, -ĭtō, -ĭtōtĕ, -untō
4.	aud-ī, -ītĕ	-ītō, -ītō, -ītōtĕ, -iuntō

Infinitive Mood

	PRESENT	PERFECT		FUTURE	
1.	ămā-	ămāv-		ămāt-	
2.	mŏnē-	mŏnŭ-		mŏnĭt-	-ūrŭs
3.	lĕgĕ- -rĕ	lēg-	-issĕ	lect-	essĕ
4.	audī-	audīv-		audit-	

	GERUNDIVE		SUPINE	
1.	ămandum		ămāt-	
2.	mŏn-		mŏnĭt-	
3.	lĕg-	-endum	lect-	-um, -ū
4.	audĭ-		audīt	

Participles

	PRESENT		FUTURE	
1.	ăm-ans		ămāt-	
2.	mŏn-		mŏnĭt-	
3.	lĕg-	-ens	lect-	-ūrŭs
4.	audĭ-		audīt-	

Passive Voice

Indicative Mood

PRESENT

	Sing.	*Plur.*
1.	ăm-, -or, -ārīs, -ātŭr	-āmŭr, -āmĭnī, -antŭr
2.	mŏn-, -ĕŏr, -ērīs, -ētŭr	-ēmŭr, -ēmĭnī, -entŭr
3.	lĕg-, -ŏr, -ĕrīs, -ĭtŭr	-ĭmŭr, -ĭmĭnī, -untŭr
4.	aud-, -ĭŏr, -īrīs, -ītŭr	-ĭmŭr, -ĭmĭnī, -iuntŭr

IMPERFECT

1.	ămā-	-băr, -bārīs or -bārĕ, -bātŭr	-bāmŭr, -bāmĭnī, -bantŭr
2.	mŏnē-		
3.	lĕgē-		
4.	audīē-		

FUTURE

1.	ămā-	-bŏr, -bĕrīs or -bĕrĕ, -bĭtŭr,	-bĭmŭr, -bĭmĭnī, -buntŭr
2.	mŏnē-		
3.	lĕg-	-ăr, -ērīs or -ērĕ, -ētŭr	-ēmŭr, -ēmĭnī, -entŭr
4.	audī-		

PERFECT

1.	ămāt-	-ŭs sum, ĕs, ĕst	-ī sŭmŭs, estĭs, sunt
2.	mŏnĭt-		
3.	lect-		
4.	audīt-		

PLUPERFECT

1.	ămāt-	-ŭs ĕram, ĕrās, ĕrăt,	-ī ĕrāmŭs, ĕrātŭs, ĕrant
2.	mŏnĭt-		
3.	lect-		
4.	audīt-		

FUTURE PERFECT

1.	ămāt-	-ŭs ĕrō, ĕrīs, ĕrĭt	-ī ĕrīmus, ĕrītĭs, ĕrunt
2.	mŏnĭt-		
3.	lect-		
4.	audīt-		

Subjunctive Mood

PRESENT

	Sing.	*Plur.*
1.	ăm-, -ĕr, -ērīs or -ērĕ, ētŭr	-ēmŭr, -ēmĭnī, -entŭr
2.	mŏnē-	-ăr, -ērīs or-ārĕ, -ātŭr	-āmŭr, -āmĭnī, -antŭr
3.	lĕg-		
4.	audī-		

IMPERFECT

1.	ămā-	-rĕr, -rērīs or -rērĕ, -rētŭr	-rēmŭr, -rēmĭnī, -rentŭr
2.	mŏnē-		
3.	lĕgē-		
4.	audī-		

PERFECT

1.	ămāt-	-ŭs, sim, sīs, sĭt	-ī sīmŭs, sītĭs, sint
2.	mŏnĭt-		
3.	lect-		
4.	audīt-		

PLUPERFECT

1.	ămāt-	-ŭs essem, essēs, essĕt	-ī essēmŭs, essētĭs, essent
2.	mŏnĭt-		
3.	lect-		
4.	audīt-		

Imperative Mood

	PRESENT	FUTURE
1.	ăm-ārĕ, -āmĭnī	-ātŏr, -ātŏr, -antŏr
2.	mŏn-ērĕ, -ēmĭnī	-ētŏr, -ētŏr, -entŏr
3.	lĕg-ere, -ĭmĭnī	-ĭtŏr, -ĭtŏr, -untŏr
4.	audī-re, -mĭnī	-tŏr, -tŏr, -untŏr

Infinitive Mood

	PRESENT	PERFECT
1.	ăm-ārī	ămāt-
2.	mŏn-ērī	mŏnĭt-
3.	lĕg-ī	lect-
4.	aud-irī	audīt-

-ŭs essĕ

FUTURE

1. ămāt-
2. mŏnĭt-
3. lect-
4. audīt-

-um īrī

Participles

	PERFECT	GERUNDIVE
1.	ămāt-	ăm-an-dŭs
2.	mŏnĭt-	mŏn-
3.	lect-	rĕg-
4.	audīt-	audī-

-ŭs

-endŭs

By continual reference to these tables the student should try, as it were, to impress a picture of the different forms of the verb on his mind.

In the pluperfect subjunctive the form **fŏrem** of the auxiliary verb **sum** is sometimes used instead of **essem.** Thus we have in the passive of **ămō**:

ămātŭs fŏrem, fŏrēs, fŏrĕt, ămātī fŏrēmŭs, fŏrētĭs, fŏrent, *I had, thou hadst, we had,* etc., *been loved.*

The perfect participle is often combined with **fŭī, fŭĕram,** and other parts of the verb **sum** formed from the perfect base **fŭ.** Thus are formed: **ămātŭs fŭī,** meaning *I was loved*

Fŏrĕ, the future infinitive of **sum,** in combination with the perfect participle, forms a future-perfect infinitive passive, thus, **ămātŭs fŏrĕ,** *to be about to have been loved.*

Exercise 11

Translate into English:—

1. Mihi non solum tu incendere iudico, sed ipse ardere videaris. 2. Quoniam de re publica multa scripserint. 3. Scribit Labieno, cum legione ad fines Nerviorum veniat. 4. Si quid hujus simile forte aliquando evenerit. 5. Quem esse negas, eundem esse dicis. 6. Ego nunquam mihi minus quam hesterno die placui. 7. Is limo turbatam haurit aquam. 8. Reliquis ex omnibus partibus colles oppidum cingebant. 9. Ex omnibus seculis vix tria aut quatuor nominantur paria amicorum. 10. Quum mea domus ardebat ignibus iniectis.

Translate into Latin:—

1. Damocles seemed to himself a fortunate person. 2. Hortensius spoke better than he wrote. 3. He used to draw water from a well. 4. He threw himself into the midst of the enemy. 5. I love you better than my own eyes. 6. Caecina warned his soldiers of the time and the emergency (necessitas). 7. The Aedui when they were unable to protect themselves and their possessions from them. 8. He sent his son to some man or other. 9. There are said to have been seven at one time who were held (or had) wise men. 10. You take away from me all hope.

E. A. B.

FRENCH.—XI

Conjugation. — THE systematic combination of all the tenses of a verb, in their different numbers and persons, is called conjugation of that verb. There are four regular conjugations in French, besides a number of irregular verbs whose conjugation differs more or less from any of these. The distinguishing mark of these four conjugations is the ending of the verb in the infinitive, as follows:

Conjugation	*Typical verb*	*Ending*
First	chanter, *to sing*	-ER
Second	finir, *to finish*	-IR
Third	recevoir, *to receive*	-OIR
Fourth	vendre, *to sell*	-RE

The imperfect of **finir,** and of by far the greater proportion of verbs ending in **-ir,** ends in **-issais** thus, **finissais.** There are nearly thirty verbs, however, usually grouped with this conjugation, with the imperfect ending in **-ais,** thus, **faillais,** imper. of **faillir,** *to fail,* **courais,** imp. of **courir,** *to run.*

Auxiliary Verbs, Avoir and Être.—The following is the conjugation in full of the two auxiliary verbs, **avoir,** *to have,* and **être,** *to be.* These have previously been given in part, and the student will have little difficulty in learning them completely. In these and other cases, the five principal parts, viz., the infinitive, present participle, past participle, present indicative, and past definite, will be given at the beginning, providing material, as already explained, for the other tenses. The principal parts of every verb should be specially noted and committed to memory.

Avoir

avoir, ayant, eu, j'ai, j'eus

Indicative Mood.

PRESENT	PAST INDEFINITE
j'ai, *I have*	j'ai eu, *I have had*
tu as	tu as eu
il a	il a eu
nous avons	nous avons eu
vous avez	vous avez eu
ils ont	ils ont eu
IMPERFECT	PLUPERFECT
j'avais, *I had* or *was having*	j'avais eu, *I had had*
tu avais	tu avais eu
il avait	il avait eu
nous avions	nous avions eu
vous aviez	vous aviez eu
ils avaient	ils avaient eu
PAST DEFINITE	PAST ANTERIOR
j'eus, *I had*	j'eus eu, *I had had*
tu eus	tu eus eu
il eut	il eut eu
nous eûmes	nous eûmes eu
vous eûtes	vous eûtes eu
ils eurent	ils eurent eu
FUTURE	FUTURE ANTERIOR
j'aurai, *I shall have*	j'aurai eu, *I shall have had*
tu auras	tu auras eu
il aura	il aura eu
nous aurons	nous aurons eu
vous aurez	vous aurez eu
ils auront	ils auront eu

Conditional Mood

PRESENT	PAST
j'aurais, *I should have*	j'aurais eu, *I should have had*
tu aurais	tu aurais eu
il aurait	il aurait eu
nous aurions	nous aurions eu
vous auriez	vous auriez eu
ils auraient	ils auraient eu

Imperative Mood

aie, *have* (thou)
qu'il ait, *let him have*
ayons, *let us have*
ayez, *have* (ye)
qu'ils aient, *let them have*

Subjunctive Mood

PRESENT	PERFECT
que j'aie, *that I may have*	que j'aie eu, *that I may have had*
que tu aies	que tu aies eu
qu'il ait	qu'il ait eu
que nous ayons	que nous ayons eu
que vous ayez	que vous ayez eu
qu'ils aient	qu'ils aient eu
IMPERFECT	PLUPERFECT
que j'eusse, *that I might have*	que j'eusse eu, *that I might have had*
que tu eusses	que tu eusses eu
qu'il eût	qu'il eût eu
que nous eussions	que nous eussions eu
que vous eussiez	que vous eussiez eu
qu'ils eussent	qu'ils eussent eu

Infinitive Mood

PRESENT	PAST INDEFINITE
avoir, *to have*	avoir eu, *to have had*
PRESENT PARTICIPLE	PAST PARTICIPLE
ayant, *having*	eu, eue, *had*

Être

être, étant, été, je suis, je fus.

Indicative Mood.

PRESENT	PAST INDEFINITE
je suis, *I am*	j'ai été, *I have been*
tu es	tu as été
il est	il a été
nous sommes	nous avons été
vous êtes	vous avez été
ils sont	ils ont été
IMPERFECT	PLUPERFECT
j'étais, *I was*	j'avais été, *I had been*
tu étais	tu avais été
il était	il avait été
nous étions	nous avions été
vous étiez	vous aviez été
ils étaient	ils avaient été
PAST DEFINITE	PAST ANTERIOR
je fus, *I was*	j'eus été, *I had been*
tu fus	tu eus été
il fut	il eut été
nous fûmes	nous eûmes été
vous fûtes	vous eûtes été
ils furent	ils eurent été
FUTURE	FUTURE ANTERIOR
je serai, *I shall be*	j'aurai été, *I shall have been*
tu seras	tu auras été
il sera	il aura été
nous serons	nous aurons été
vous serez	vous aurez été
ils seront	ils auront été

Conditional Mood.

PRESENT	PAST
je serais, *I should be*	j'aurais été, *I should have been*
tu serais	tu aurais été
il serait	il aurait été
nous serions	nous aurions été
vous seriez	vous auriez été
ils seraient	ils auraient été

Imperative Mood.

sois, *be* (thou)
qu'il soit, *let him be*
soyons, *let us be*
soyez, *be* (ye)
qu'ils soient, *let them be*

Subjunctive Mood.

PRESENT	PERFECT
que je sois, *that I may be*	que j'aie été, *that I may have been*
que tu sois	que tu aies été
qu'il soit	qu'il ait été
que nous soyons	que nous ayons été
que vous soyez	que vous ayez été
qu'ils soient	qu'ils aient été
IMPERFECT	PLUPERFECT
que je fusse, *that I might be*	que j'eusse été, *that I might have been*
que tu fusses	que tu eusses été
qu'il fût	qu'il eût été
que nous fussions	que nous eussions été
que vous fussiez	que vous eussiez été
qu'ils fussent	qu'ils eussent été

Infinitive Mood.

PRESENT	PAST INDEFINITE
être, *to be*	avoir été, *to have been*
PRESENT PARTICIPLE	PAST PARTICIPLE
étant, *being*	été, *been*

Note that while the past participle **eu, eue,** *had,* is variable, **été,** *been,* is invariable.

VOCABULARY

ainsi, *so, thus.*
attendez, *wait* (ye).
avoir honte, *to be ashamed.*
un caprice, *a caprice.*
un chagrin, *an annoyance, a trouble.*
condamné, *condemned.*
la dame, *the lady.*
de même, *the same.*
dès, *since.*
digne, *worthy.*
l'exercice (m.), *exercise, occupation.*
favorable, *favourable.*
le jour, *day, daylight.*
la main, *the hand.*
malheureux, *unfortunate.*
la nuit, *night.*
un parent, *a parent.*
une partie, *a part.*
la patience, *patience.*
pauvre, *poor,*
un peu, *a little.*
la peur, *fear.*
le plaisir, *pleasure.*
si, *if.*
si, *so.*
soumis, *submissive, obedient.*
le tableau, *the picture.*
tout de suite, *at once.*
voir, *to see.*
le voyage, *the journey.*
vulgaire, *vulgar, commonplace.*

Exercise 19

1. Ils ont une grande maison et un beau jardin. 2. Il aurait une belle place. 3. J'aurai trop de plaisir à le faire. 4. Ayez un peu de patience, attendez. 5. Avez-vous de l'argent? 6. Je n'en ai pas assez. 7. Elle le fut dès cette première nuit-là. 8. Je suis content de vous avoir rencontré. 9. Eh bien, non, ce n'était pas cela. 10. J'ai pris mon courage à deux mains. 11. Nous fûmes les vrais amis de ce jeune homme malheureux. 12. Était-il digne d'être l'époux d'une si grande dame? 13. Elle n'avait rien de ces peurs vulgaires. 14. Et si c'était ainsi le jour, il en était de même une grande partie de la nuit. 15. Tels étaient les miserables exercices auxquels elle m'avait condamné. 16. N'était-ce qu'un caprice? 17. Ayez plus de courage. 18. Que j'eusse bien plus d'argent. 19. Nous aurions eu un beau voyage. 20. Soyez soumis à vos parents.

Exercise 20.

1. I am very unfortunate. 2. Thou art a great poet. 3. He is a wine-merchant. 4. We are very poor. 5. Are you satisfied? 6. They are pleased to see him. 7. I am ashamed to say it. 8. Thou art right. 9. He has not the courage. 10. We wish to walk. 11. You are wrong. 12. You have a fine house. 13. They have many troubles. 14. I had had a large library. 15. We had a big field and a fine garden. 16. We should be ashamed to do that. 17. We shall be ready at once. 18. The wind will be favourable. 19. It would be a fine picture. 20. It would be the first time.

E. A. B.

GERMAN.—VIII

The Passive Voice.—All transitive verbs form the tenses of the passive voice with the tenses of the verb werden followed by the Past Part. of the verb that is being conjugated. We will now give the Passive Voice of the verb ſchneiden, to cut; the first pers. only of each tense will be given, as the student can easily form the other pers. himself.

Note.—When used as an auxiliary after a Past Part. the Past Part. of werden, i.e. geworden, drops the prefix ge and becomes worden.

Infin. pres. geſchnitten werden *to be cut.*
perf. geſchnitten worden ſein.
Participles, pres. geſchnitten werdend.
past geſchnitten worden.

Indicative : Present	*Conjunctive : Present*
ich werde geſchnitten *I am cut.*	ich werde geſchnitten *I may be cut.*
Preterite ich wurde geſchnitten *I was cut.*	*Past* ich würde geſchnitten *I might be cut.*
Future ich werde geſchnitten werden *I shall be cut*	*Future* ich werde geſchnitten werden *I shall be cut.*
Perfect ich bin geſchnitten worden *I have been cut.*	*Perfect* ich ſei geſchnitten worden *I may have been cut.*
Pluperfect ich war geſchnitten worden *I had been cut.*	*Pluperfect* ich wäre geſchnitten worden *I might have been cut.*
Future Perfect ich werde geſchnitten worden ſein *I shall have been cut*	*Future Perfect* ich werde geſchnitten worden ſein *I shall have been cut.*

Alternative Form of Past Conjunctive
ich würde geſchnitten werden
I should be cut.

Alternative Form of Pluperfect Conjunctive
ich würde geſchnitten worden ſein
I should have been cut.

Imperative
werde geſchnitten
be (thou) *cut.*

The student must note that the Past Part. of the verb in the Passive Voice is placed immediately after the finite part of the verb werden, consequently it comes last in the simple tenses, but precedes the Infinitives and Past Participles in the compound tenses.

Irregular Verbs of the Weak Conjugation.—A few verbs whose stems end in nn or nd change the stem vowel e to a in the Pret. Ind. and in the Past Part. They, however, retain the original vowel e in the Pret. Conj.

Thus—

Infinitive		*Pret. Ind.*	*Pret. Conj.*	*Past Part.*
brennen,	*burn*	brannte	brennte	gebrannt
kennnen,	*know*	kannte	kennte	gekannt
nennen,	*name*	nannte	nennte	genannt
rennen,	*run*	rannte	rennte	gerannt
ſenden,	*send*	ſandte	ſendete	geſandt
wenden	*turn*	wandte	wendete	gewandt

Note. — The last two, ſenden, wenden, have alternative forms that are quite regular, thus ſendete geſendet and wendete gewendet.

Two other verbs are irregular, but as their forms are very similar to the English ones, they will probably present no difficulty. They are :—

bringen,	*bring*	brachte	brächte	gebracht
denken,	*think*	dachte	dächte	gedacht

Modal Auxiliaries.—There are six in German, but the student should clearly grasp the fact that they are not auxiliaries in the sense in which we used the word before, since they never give up their own proper meaning. These verbs are :—

dürfen,	*to be allowed*	müſſen,	*must*
können,	*can*	ſollen,	*shall*
mögen,	*may, like*	wollen,	*will*

It is to be noted that these verbs are not defective as are their English equivalents. They are all fully conjugated with the exception of the Imperative, which all except wollen lack.

The sing. of the Pres. Ind. of these verbs properly belongs to the Pret. of strong verbs; they are, in fact, old Pret. forms, and the new Pret. is formed from the unmodified stem of the plur. of the Pres. Ind. by the addition of te, etc., as in ordinary verbs of the weak conjugation.

We shall therefore give the whole of the Pres. Ind. in full for each verb, but it will be sufficient to give the 1st pers. of the other simple tenses, i.e. of the Pret. Ind. and of the Pres. and Past Conj., since as far as all else is concerned the conjugation of these verbs is quite regular.

Pres. Ind.

ich darf	kann	mag	muß	ſoll	will
du darfſt	kannſt	magſt	mußt	ſollſt	willſt
er darf	kann	mag	muß	ſoll	will
wir dürfen	können	mögen	müßen	ſollen	wollen
ihr dürft	könnt	mögt	müßt	ſollt	wollt
Sie dürfen	können	mögen	müßen	ſollen	wollen
ſie dürfen	können	mögen	müßen	ſollen	wollen

Pret. Ind.

ich durfte	konnte	mochte	mußte	ſollte	wollte

Pres. S. Conj.

ich dürfe	könne	möge	müße	ſolle	wolle

Past Conj.

ich dürfte	könnte	möchte	müßte	ſollte	wollte

Pres. Part.

dürfend	könnend	mögend	müßend	ſollend	wollend

		Past Part.			
gedurft	gekonnt	gemocht	gemußt	gefollt	gewollt
		Pres. Inf.			
dürfen	können	mögen	müßen	ſollen	wollen
		Past Inf.			
gedurft haben, gekonnt haben, gemußt haben, gefollt haben, gewollt haben					
		Imperative			
wolle, wollt					

The Future and Perfect tenses are formed exactly like those of other verbs, thus :—

Ind. Perf. ich habe gedurft, gekonnt, gemocht, gemußt, gefollt, gewollt
Pluperf. ich hatte gedurft, gekonnt, etc.
Fut. ich werde dürfen, können, mögen, müßen, ſollen, wollen
Fut. perf. ich werde gedurft haben, gekonnt haben, etc.
Conj. Perf. ich habe gedurft, gekonnt, etc.
Pluperf. ich hätte gedurft, gekonnt, etc.
Alternat. of Past ich würde dürfen, können, etc.
Alternat. of Pluperf. ich würde gedurft haben, gekonnt haben, etc.
Fut. ich werde dürfen, können, etc.
Fut. Perf. ich werde gedurft haben, gekonnt haben, etc.

There is one very important point that the student must note well; when used with the Infin. of another verb which is not an auxiliary, the Infin. of the above verbs is substituted for the Past Part. in the Perf. and Pluperf. tenses. Ich habe es nicht gewollt *I did not wish* (or *want*) *it*, but Ich habe es nicht ſehen wollen, *I did not wish* (or *want*) *to see it*.

Two other verbs call for special mention as being irregular. The first of these is wiſſen, *to know*, which is not unlike the above in that its Pres. Ind. is really an old Pret.

Pres. Ind	*Pret. Ind.*	*Past Conj.*	*Past Part.*
ich weiß	ich wußte	ich wüßte	gewußt
du weißt			
er weiß			
wir wiſſen			
ihr wiſſet			
Sie wiſſet			
ſie wiſſen			

The student will have noticed that there is another verb for to know, namely kennen. The difference between wiſſen and kennen is the same as between savoir and connaître in French; the former means *to know in one's mind*, i.e. to possess as mental property; the latter means *to be acquainted with*. Ich kenne das Buch, *I know* (am acquainted with) *that book*, but Ich weiß die erſte Seite auswendig, *I know* (in my mind) *the first page by heart*. The second verb is tun, *to do*.

Pres. Ind.	*Pret. Ind.*	*Past Conj.*	*Past Part.*
ich tue	ich tat	ich täte	getan
du tuſt			
er tut			
wir tun			
ihr tut			
Sie tun			
ſie tun			

It would really have been sufficient to give the Pres. and Pret. Ind. together with the Pres. Infin. and Past Part. of the above verbs, as the student should then be able to conjugate them in full, but the Past Conj. has been added so that he may realize that the vowel of the Ind. is modified in the Conj.

We may note here that there are a few other verbs which, like the Modal Auxiliaries, substitute the Infin. for the Past Part. when used in conjunction with the Infin. of another verb. The commonest of these are ſehen, *to see*, and hören, *to hear*. Thus, ich habe ihn geſehen, *I have seen him*, but ich habe ihn kommen ſehen, *I have seen him come*.

VOCABULARY

Fuchs, s.m.2, *fox*.
kommen, s., *to come*.
Herde, w.f., *flock*.
ſitzen, s.1 d., *to sit*.
ſprechen, s.1 c., *to speak, say*.
beiſammen, *together, in a group*.
auf'freſſen, s.2 a., *eat up*.
vor, *from, owing to*, gov. dat.
auf'ſpringen, s.1 a., *to jump up*.
jammern, w., *to lament*.
bitten, s.1 d., *to ask, beg*.
Gnade, w.f., *mercy*.
endlich, *at last*.
laſſen, s.2 c., *to let, leave*.
einzig, *only, single*.
Gebet, s.n.2, *prayer*.
Sünde, w.f., *sin*.
Reihe, w.f., *row*.
aus'ſuchen, w., *to pickout, choose*.
fromm, *pious, innocent*.
beten, w., *to pray*.
alſo, *therefore, so*.
recht, *right, very*.
zweit, *second*.
an, *to*, gov. dat. and acc.
dritt, *third*.
folgen, w., *to follow*, gov. dat.
zuſammen, *together*.
wenn, *if*.
weiter, *further*.
alleweil, *meanwhile*.
Gans, s.f.2, *goose*.
Wieſe, w.f., *meadow*.
fett, *fat*.
lachen, w., *to laugh*.
rufen, s.2 d., *to call*.
ſo, *thus*.
ander, *other*.
gackern, w., *to cackle*.
Schreck, w.m., *fright*.
anfangen, s.2 c., *to begin*.
kläglich, *pitiful*.
um, *for*, gov. acc.
ſterben, s.1 c., *to die*.
nehmen, s.1 c., *to take*.
ſo, *then*.
erzeigen, w., *to show*, gov. dat. of person.
erlauben, w., *to allow*, gov. dat. of person.
damit, *so that, in order that* (conjn.).
hernach, *afterwards*.
ſtellen, w., *to place*.
billig, *fair*.
Bitte, w.f., *request*.
warten, w., *to wait*.
erſt, *first*.
auf'hören, w., *to leave off*.
bis, *till, until*.
ſondern, *but*.
viert, *fourth*.
bald, *soon*.
all, *all*.
aus'beten, *to finish praying*.
erzählen, w., *to tell*.
fort, *on, away*.

Exercise 23

Der Fuchs und die Gänſe.

Der Fuchs kam einmal auf[1] eine Wieſe, wo[2] eine Herde ſchöner fetter Gänſe ſaß, da lachte er und ſprach „ich komme ja wie[3] gerufen, ihr ſitzt hübſch[1] beiſammen, ſo kann ich eine nach der andern auffreſſen[5]". Die Gänſe

gackerten vor Schrecken, ſprangen auf[1], fingen an[7] zu jammern und kläglich um[8] ihr Leben zu bitten. Der Fuchs aber wollte auf nichts hören[9] und ſprach „da iſt keine Gnade, ihr müßt ſterben.“ Endlich nahm ſich eine das Herz[10] und ſagte „ſollen[11] wir armen Gänſe doch[13] einmal unſer Leben[12] laſſen, ſo[14] erzeige uns die einzige Gnade und erlaube uns noch ein Gebet, damit wir nicht in unſern Sünden ſterben: hernach wollen wir uns auch[15] in eine Reihe ſtellen, damit du dir immer die fetteſte ausſuchen[16] kannſt.“ „Ja,“ ſagte der Fuchs, „das iſt billig, und iſt eine fromme Bitte: betet, ich will ſo lange warten.“ Alſo fing[17] die erſte ein recht langes Gebet an, immer „ga, ga“, und weil ſie garnicht aufhören[18] wollte, wartete die zweite nicht bis die Reihe[19] an ſie kam, ſondern[20] fing auch an „ga, ga“. Die dritte und vierte folgten ihr, und bald gackerten ſie alle zuſammen. (Und wenn ſie ausgebetet[21] haben ſoll das Märchen weiter erzählt[22] werden, ſie beten[23] aber alleweil[24] noch immer fort.)

NOTES:—

(1) auf indicating motion, governs the acc. (2) wo is used as a relative adverb as well as an interrog. adv. (3) wie here means as if. (4) hübſch, used as an adjv., means nicely. (5) auffreſſen—the prefix is separable, as is indicated by the accent on it in the vocabulary; freſſen is used of animals, eſſen of people. (6) ſprangen auf—the separable prefix is placed at the end, as it is used in a principal clause. (7) fingen an, see (6). (8) um etwas bitten is to ask for something. (9) hören auf is to listen to. (10) ſich das Herz nehmen, to take the heart for oneself, i.e. to take heart; the reflex. pron. ſich is in the dat. (11) ſollen wir—the inverted order is equivalent to a conditional clause. (12) das Leben laſſen—to leave the (i.e. one's) life, i.e. to lose one's life. As in French, the def. art. is often used instead of the poss. adj. Note that Leben is in each case used in the sing., not, as in English, in the plur. (13) doch einmal—this is emphatic, and means after all. (14) ſo, often introduces the prin. clause after a conditional. (15) auch need not be translated, or can be rendered indeed. (16) ausſuchen, see (5); dir is here used as a reflex. pron. dat.; ſich ausſuchen, is to choose for oneself. (17) fing an, see (5). (18) aufhören, see (5). (19) Reihe—here means turn. (20) ſondern is always used instead of aber after a negative clause. (21) ausgebetet (see 5), a separable prefix, but as it occurs in a dependent clause it is not separated from the verb. The prefix aus is often used in the sense of doing a thing to the end or to the greatest possible extent. (22) erzählt werden — this is the passive voice. (23) fortbeten, see (6); the prefix fort is used in the sense of continuing to do a thing. (24) alleweil—only used in South German dialects.

Exercise 24

1. We came on to a field yesterday where we saw two foxes and a flock of fine geese. The foxes wanted to eat up the geese which were sitting in a row. But they jumped up one after the other, and cackled so that the foxes ran away (weglaufen s.2 d.) from fright. I could not hear what my friend said when the geese began to cackle. I wish you had been allowed to come with us; you would have laughed. We waited for you till it was late, then we had to go. You must come to see us soon.

2. Account for the cases of the following: ſchöner fetter Gänſe, der andern, Leben, das Herz, unſern Sünden, eine Reihe.

3. Account for the order of words in the following: da lachte er, ſo kann ich, damit wir .... ſterben, wartete die zweite, die Reihe .... kam.

Key to Exercise 21

I do not know what it should mean that I am so sad; a fairy tale of olden times will not come out of my mind. The air is cool and it is growing dark, and the Rhine flows calmly; the summit of the hill sparkles in the evening sunshine. The most beautiful maiden sits up there wonderful. Her golden jewels flash; she combs her golden hair. She combs it with a golden comb and sings a song with it; that has a marvellous, mighty melody. The boatman in little boat is seized with wild woe; he does not see the reefs of rock; he only looks up into the height. I think the waves swallow the boatman and small boat in the end; and that the Lorelei has done with her singing.

The above is a literal rendering of Heine's well-known ballad; we will now give a translation into better English.

I do not know why I am so sad; a legend of olden times haunts me. The air is cool and twilight is falling, and the Rhine is flowing peacefully; the hilltop sparkles in the evening sunshine. A wondrously beautiful maiden sits there on high; her golden jewels flash; she combs her golden hair. She combs it with a golden comb, and meanwhile sings a song with a marvellous and mighty melody. The boatman in his little boat is overcome with wild yearning; he does not see the reefs, he only gazes upwards. I think in the end the waves engulf both boatman and boat; Lorelei brought this to pass with her singing.

Key to Exercise 22

1.—Bin, the finite verb in a dependent clause, is placed at the end, getan being a Past Part. forming with the auxiliary hat, the Perf. Ind. of tun is placed at the end of the clause.

2.—

Infin.	*Past Part.*	*Ind. Pres.*	*Ind. Pret.*	*Conj. Past*
kommen	gekommen	komme	kam	käme
		kommſt	kamſt	kämeſt
		kommt	kam	käme
		kommen	kamen	kämen
		kommt	kamt	kämet
		kommen	kamen	kämen
fließen	gefloßen	fließe	floß	flöße
		fließe	floßeſt	flößeſt
		etc.	etc.	etc.
		ſitzt	ſaßt	ſäßeſt
		etc.	etc.	etc.
ſitzen	geſeſſen	ſitze	ſaß	ſäße
		ſitzt	ſaßt	ſäßeſt
		etc.	etc.	etc.
blitzen	geblitzt	blitze	blitzte	blitzte
		etc.	etc.	etc.
ſingen	geſungen	ſinge	ſang	ſänge
		etc.	etc.	etc.
ergreifen	ergriffen	ergreife	ergriff	ergriffe
		etc.	etc.	etc.
verſchlingen	verſchlungen	verſchlinge	verſchlang	verſchlänge.

3.—Sinn dat. gov. by aus. Berges gen. dependent on Gipfel. Haar acc. gov. by trans. verb kammt. Kamme dat. gov. by mit. Schiffer, acc. gov. by trans. verb verſchlingen. Hoh, acc. gov. by in indicating motion. das, acc. of neut. demons. pron. gov. by trans. verb getan.

M. A. L.

Continued from page 103.

GEOGRAPHY:

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CURRENTS

To all intents and purposes the surface currents of the ocean are caused by the winds. Other contributing causes exist, but they are so comparatively unimportant that they may be neglected here.

There are, in general, two directions from which winds blow, one on each side of the Equator. In the northern hemisphere we have the North-East Trade Winds blowing regularly from the N.E.

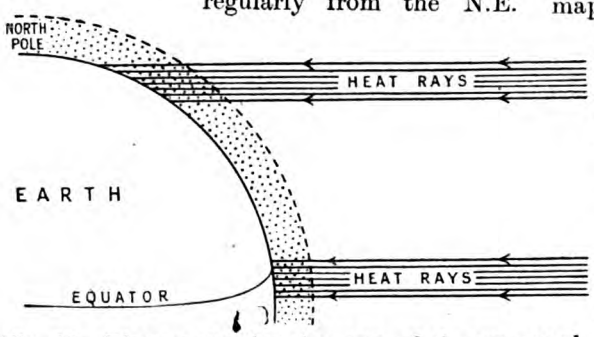


Fig. 32.—Diagram showing that rays of the sun travel through a greater thickness of atmosphere near the poles than near the equator.

towards the S.W. between latitude 35° N. and 6° N., and in the southern hemisphere the South-East Trades blowing from S.E. to N.W. through a corresponding range of latitude. These two regular winds meet somewhere about the Equator and form a resultant wind moving in a westerly direction.

Action of the Wind

This westerly wind, acting on the surface of the sea, sets up an ocean current. If the surface of the earth consisted only of water we should thus get a westerly current flowing all round the earth at the Equator. But we have the continents of America and Africa extended in a north and south line directly across its path, and these deflect it into various other currents.

The various ocean currents form a series of rings or groups arranged as a kind of vortex with a central portion of comparatively still water. In the Atlantic Ocean, for instance, there is north of the Equator a vortex flowing in the direction of the hands of a clock, whereas south of the Equator the vortex flows in a counter-clockwise direction. Actually however currents are not so simple.

The various currents actually formed are very permanent phenomena, and go by different names, which are marked on maps or charts, showing their directions. Some currents are warmer than the general temperature of the ocean through which they flow, and some are colder, and they are accordingly known as warm and cold currents respectively.

Climate

Climate is a generic term used to express the character of the weather in any particular region of the earth. It depends upon many factors, the most important being latitude, height above the sea, distance from the sea, and the geographical structure of the country considered. The most important elements of climate are temperature, moisture (whether as direct rainfall or general humidity, etc.), and wind.

In olden times the world was divided into five climate zones: the Torrid, lying along the Equator, the North and South Temperate zones on either side of this, and the Frigid zones towards and up to the Poles. This would tend to cause climate to be looked upon as merely a question of latitude, which, though an important factor, is only one of a number of causes influencing it.

Latitude has its greatest influence in determining the length of the day and the intensity of the sunshine. All round the earth is a gaseous envelope known as the Atmosphere, which has an effective height of some 45 miles. If the sun is shining directly above a certain place on the earth the thickness of the atmosphere through which its heat and

light rays have to pass is at a minimum. If, however, the rays fall obliquely, a much greater thickness of the atmosphere has to be traversed before they reach the surface of the globe.

Now, in what are called high latitudes,

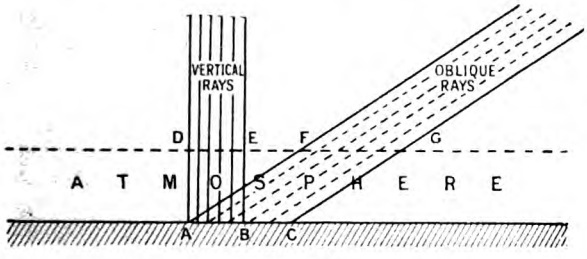


Fig. 33.

Vertical Rays traverse D.A.B.E. & give light & warmth to A.B.

Oblique Rays traverse A.F.G.C. & give light & warmth to A.C.

that is in regions nearer the Poles, the sun's rays may have to pass through twice as great a thickness of the atmosphere as if they were passing vertically through it, and thus much of the heat and light is absorbed before they reach the earth's surface. The same effect is, of course, produced in all latitudes diurnally; but in the regions around the Poles the rays of the sun never strike the earth perpendicularly.

Dark Heat Rays

The atmosphere itself is warmed not only by the rays of the sun which it intercepts in their passage to the earth, but also by radiation from the earth itself, which has been warmed by those rays that have reached it. These latter radiations are not luminous, as are the direct sun rays, and are known as dark heat rays. Now, the atmosphere cannot transmit these dark heat rays as it did the direct sun rays, as it is more or less opaque to this class of radiation. The consequence of this is very important. If there were no atmosphere to intercept the dark heat rays they would, in the night, be radiated out again, and the temperature of the earth would fall to many degrees below freezing point. Air in which aqueous vapour is present is nearly 100 times more absorptive of dark heat rays than dry air, and for this reason we find that in the very dry regions where there is little or no aqueous vapour in the atmosphere, the heat gained in the day is rapidly radiated away when the sun sets, giving very extreme ranges of temperature between day and night.

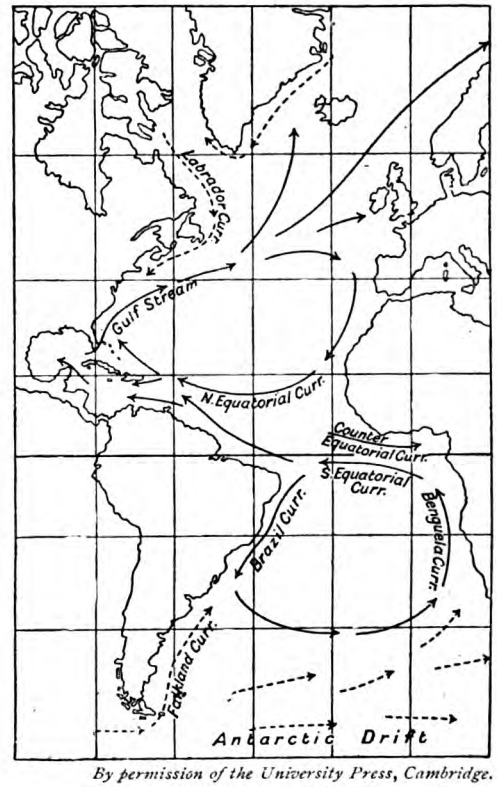
This phenomenon accounts for the fall in temperature when we rise to heights above the sea level, or, as it is called, to the "vertical distribution of temperature." The average fall of temperature for elevations up to about 7 miles is 1° Fahr. for 304 feet.

Water requires more heat to raise its temperature through a given number of degrees than any other substance, and when it is cooled through a given range of temperature it gives out a greater amount of heat than any other substance.

Island Temperatures

The consequence is that in summer the ocean is not heated to so great an extent as is the land by the sun's rays; but in winter an equal loss of heat does not cool the ocean (and in consequence the air over it) to so great an extent as the land is cooled.

This accounts for the temperature of islands and, generally, lands situated near to the sea. As they are in the



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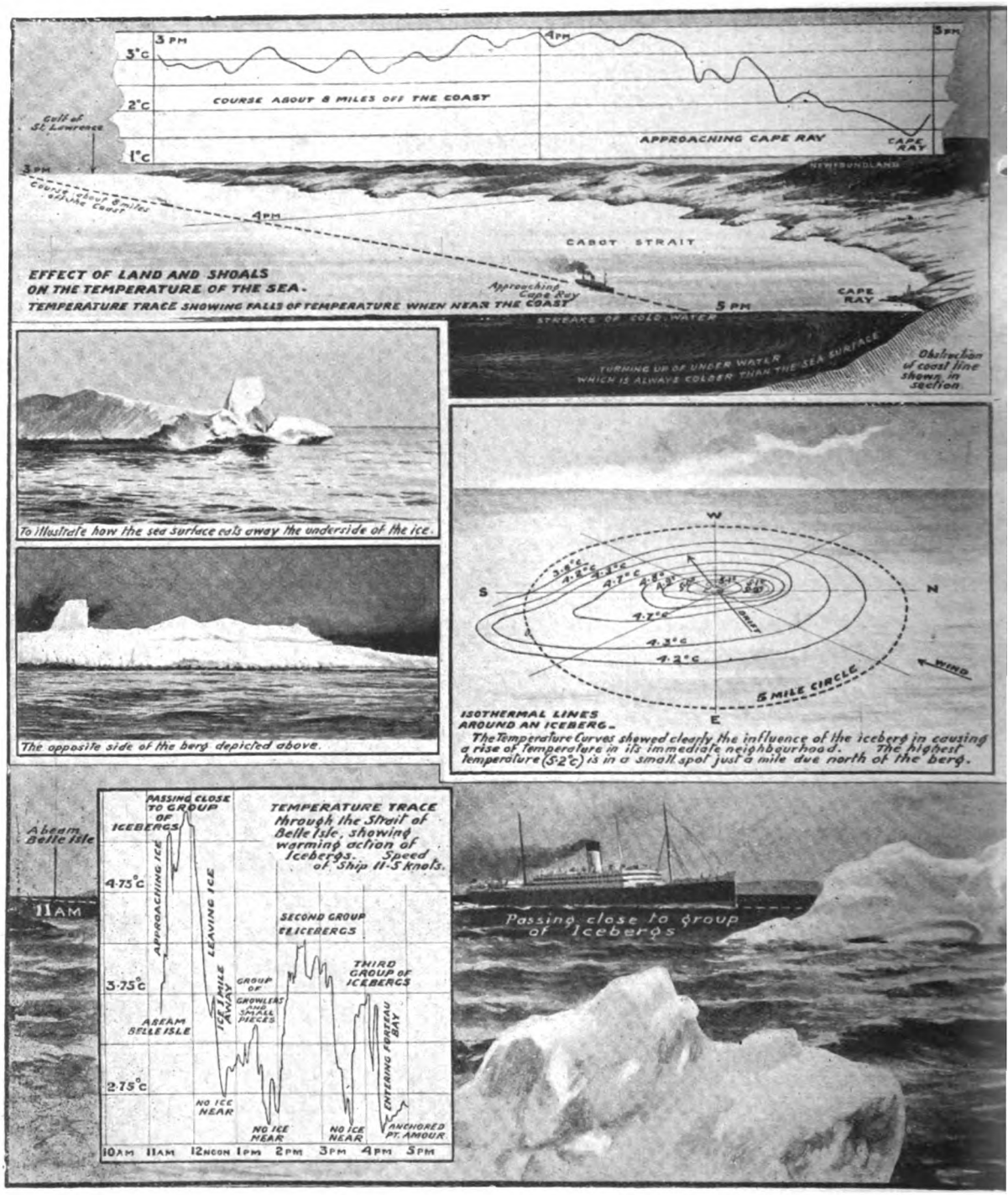
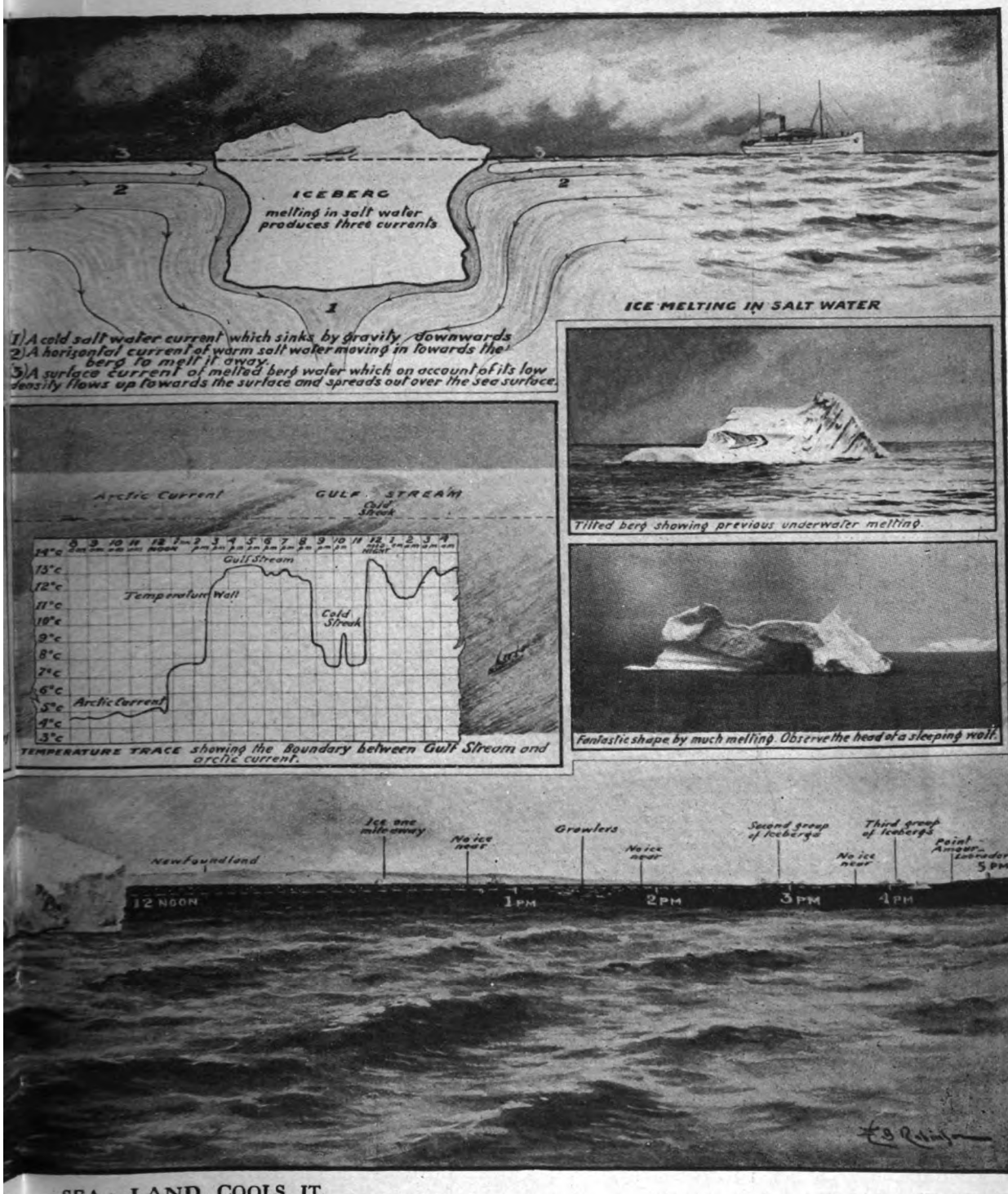
ATLANTIC OCEAN CURRENTS.

N. of the Equator a vortex flows in a clockwise direction; S. of the Equator anti-clockwise. The dotted arrows indicate Polar currents.



ICEBERGS WARM THE

The above diagrams illustrate the remarkable results which have been yielded by experiments in "dragging" affect the thermometer first by a rise and then, as the ship passes abeam the berg, by a fall, the rise being nearness to coastlines brings about a fall, due mainly to the obstruction offered by the land,



SEA; LAND COOLS IT.

a micro-thermometer in the Atlantic. Icebergs at a distance of $\frac{1}{2}$ to $\frac{1}{4}$ of a mile from an approaching ship due to the comparative warmth of the iceberg, the fall to the cold current in which it is borne. Again, resulting in the turning up of the under water, which is always colder than that on the surface.

proximity of a large amount of water, the annual range of temperature is very small compared with that of a region far removed from the ocean; Great Britain, for instance, is said to enjoy an "insular climate," the mean annual range of temperature being about 20° Fahr., whereas a place like Moscow has a "continental climate," the annual range of temperature being 35° Fahr. A very extreme example illustrating this point is that of Verkhoyansk, in Siberia, which has an annual range of temperature of about 116° Fahr., whereas the Lofoten Islands, in the same latitude, have one of only 23° Fahr.

Influence of Icebergs

The influence of icebergs on ocean temperatures is well illustrated by the thermometer readings taken by passing ships. Icebergs at a distance of $\frac{1}{2}$ to $\frac{1}{4}$ of a mile from an approaching ship affect the thermometer first by a rise and then, as the ship passes abeam the berg, by a fall of temperature. The rise is due to the comparative warmth of the iceberg; the fall is due to the coldness of the current in which the iceberg is borne.

Another factor to be considered is the accumulative heating action of radiation on the surface of the sea. The cooling action of an iceberg is enormously less.

The nearness of mountain ranges has a great effect on districts situated to the leeward, that is, sheltered from the prevailing winds, as they are thereby deprived of a large proportion of their moisture. Thus many places have cooler winters and hotter summers than regions lying on the other side of a range of mountains, owing to the fact that, as noticed above, a large proportion of aqueous vapour tends to equalise the summer and winter temperatures. The nature of the soil also has an effect on the climate.

Sandy soils, which hold little moisture, are dry, whereas a soil containing much clay, which holds perhaps 20 times as much water, renders the air above it damp and cold.

Nearness to coastlines brings about a fall in ocean temperatures. In experiments made in the North Atlantic, the general effect of land on the lowering of ocean temperatures was proved and illustrated by successive falls in the isotherms within approximately six miles of the coast. This drop right up to the coastline is due to the actions of the tides, and the obstruction offered by the coastline resulting in the turning up of the under water, which is always much colder than the surface water.

Winds influence climate greatly, as they bring with them the characteristic climatic features of the districts whence they blow. In Great Britain, for example, we have prevailing south-westerly winds which, traversing wide stretches of the Atlantic, cause the climate to be moist and warm.

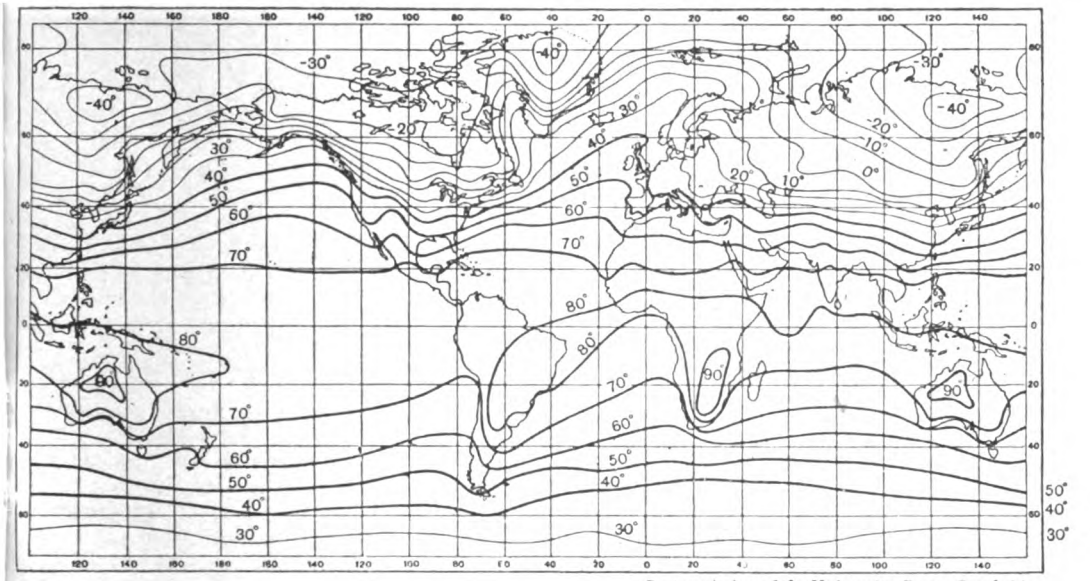
Rain is also an important factor in climate, as, apart from the purification of the atmosphere which results after rainfall, the humidity is, at any rate for a time, reduced. It may also be noticed here that a moderate annual rainfall spread over a long period of time, such as occurs in Ireland, makes for a wet climate; whereas a much greater annual rainfall occurring in a few months of the year only, as in many tropical countries, may be characteristic of a dry climate.

To a certain extent Temperature has been considered under Latitude, and it is, roughly speaking, characteristic that as we approach the Poles from the Equator the temperature falls owing to the obliquity with which the sun's rays strike the earth. But we must now discuss how, apart from mere differences of latitude, this factor varies in different parts of the earth.

The air receives less than one-half its heat from the direct rays of the sun; the rest it derives by conduction from the surface of the earth after it has been heated by the sun. When the atmosphere in contact with the earth becomes heated, it expands and, rising, mixes with cooler air above. This process is called convection. The difference in atmospheric temperatures as seen over the face of the earth show the influence of conduction, convection, and radiation as determined by the distribution of land and water and general orographical features.

Isothermal Maps

Maps are constructed showing lines which join up places that have the same temperature, and these lines, called isotherms, are drawn for differences of temperature of 10° Fahr. If we look at an isothermal map showing the mean January isotherms for the world we notice that these are much more irregular over the northern hemisphere in the middle and high latitudes than in the southern hemisphere. This is due principally to the way in which the land and water are distributed. South of the Equator there is little land, and thus the atmosphere, which holds much water vapour, is effective



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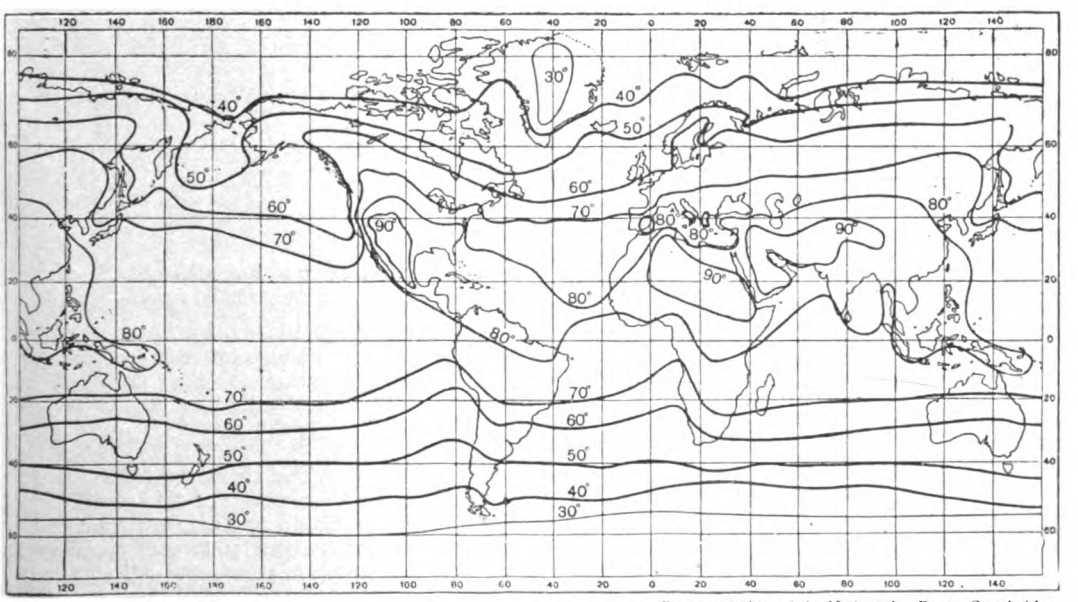
JANUARY ISOTHERMS.

in diminishing radiation. On the other hand, we notice that over the vast land surfaces of Asia the chilling influence of radiation is very marked. A careful comparison of the January and July isotherms, as shown in the annexed maps, is very interesting when the points touched upon are borne carefully in mind.

It will be interesting to note that in the case of the British Isles our winter temperature depends largely on the heat given out in the precipitation of rain, the wet districts being the warmest. The temperature "gradient" is thus roughly in the same direction as the rain-bearing winds, i.e. S.W. to N.E. In summer the gradient is roughly S. to N.

The isotherms are, of course, in both cases at right angles to the temperature gradient. C. J. S.



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JULY ISOTHERMS.

Continued from page 110.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.

(M. A. Lewenz, M.A.[Lond.]).

ARITHMETIC.—XI

94. Compound Multiplication is the method of finding the amount of any given compound number when it is repeated a given number of times.

Examples :—

(1) Multiply £14 3s. 7½d. by 7.

£	s.	d.	
14	3	7½	½d. multiplied by 7 = 7 halfpence
		7	= 3 pence and 1 halfpenny. Put
			down ½d. and carry 3d.; 7d. × 7
			= 49d.; (49 + 3)d. = 52d.
£99	5	4½	= 4s. 4d.; put down 4d. and carry 4s.;
			3s. × 7 = 21s.; (21 + 4)s. = 25s.

= £1 5s.; put down 5s. and carry £1; £14 × 7 = £98; £(98 + 1) = £99.

∴ the total amount = **£99 5s. 4½d.**

When the multiplier exceeds 12 it is easier to split it up either into factors or into parts which factorise. Thus, to multiply by 18, multiply by 9 and then by 2. To multiply by 29, multiply by 4 × 5; then multiply the original compound number by 9, and add the results (29 = 20 + 9 = 4 × 5 + 9).

(2) Multiply £7 16s. 3¼d. by 29.

£	s.	d.	
7	16	3¼	
		4	
31	5	1	= £7 16s. 3¼d. × **4**
		5	
156	5	5	= £31 5s. 1d. × 5
70	6	5¼	= £7 16s. 3¼d. × 9
£226	**11**	**10¼**	= £7 16s. 3¼d. × 29.

Where there are farthings it facilitates matters to multiply by an even factor first, if possible by 4, so as to get rid of the farthings in the product.

Similar methods apply to other compound numbers: e.g. to multiply by 37, multiply by 5 × 7; then multiply the original compound number by 2 and add the results (37 = 35 + 2 = 7 × 5 + 2).

95. Compound Division is the method of

(*a*) Dividing a given compound number into as many equal parts as there are units in the divisor, if this latter is an abstract number.

(*b*) Finding how many times one compound number is contained in another compound number of the same kind.

When the divisor is an abstract number.

Examples :—

(1) Divide £360 12s. 5d. by 23.

£	s.	d.		
23) 360	12	5	(£15 13s. 7d.)	First subtract 1
130				times 23 from 36,
15				that leaves 13; then
20				subtract 5 times
				23 from 130, that
312s.				leaves 15. Next re-
82				duce the £15 to shillings and
13				add in the 12s., which gives
12				312s. Subtract 1 times 23
				from 31, that leaves 8; then
161d.				subtract 3 times 23 from 82,
. . .				that leaves 13. Next reduce
				the 13s. to pence and add
				in the 5d., which gives 161d.
				Lastly, subtract 7 times 23
				from 161, which leaves
				nothing.

Our quotient therefore is **£15 13s. 7d.**

When the divisor can be factorised we proceed as follows :—

(2) Divide £30 7s. 3d. by 24.

£	s.	d.	
24 { 8) 30	7	3	
3) 3	15	10⅞	$\left(\frac{1\frac{7}{8}}{3} = \frac{\frac{15}{8}}{3} = \frac{5}{8}\right)$
1	**5**	**3⅝**	

When dividing by 10, 100, 1000, etc., recourse may be had to decimals, thus :—

(3) Divide £7842 10s. 6d. by 100.

£78·42	10	6	We point off as decimals 2
20			figures to the right of each
			dividend. The result is :—
8·50s.			£78 8s. 6·06d. =
12			**£78 8s. 6$\frac{3}{50}$d.**
			The student should prove the
6·06d.			correctness of this result.

If we have to divide by a number like 1400, we divide first by 7, then by 2, and then by the method of Example 3, since 1400 = 7 × 2 × 100.

96. When the divisor and dividend are both compound numbers of the same kind, both must first be reduced to the same denomination.

Example:—

How many times is 4s. $6\frac{3}{4}$d. contained in £4 11s. 3d.?

s.	d.
4	$6\frac{3}{4}$
12	
54d.	
4	
219 farthings	

£	s.	d.
4	11	3
20		
91s.		
12		
1095d.		
4		
4380 farthings		

219) 4380 (20

. . . .

219 farthings are contained exactly **20** times in 4380 farthings.

97. To express one compound number as a fraction of another compound number of the same kind.

Examples:—

(1) Express 6s. 8d. as a fraction of £1.

6s. 8d. = 80d.; £1 = 240d.

1d. = $\frac{1}{240}$ of 240d. ∴ 80d. = $\frac{80}{240}$d. of 240d. = $\frac{1}{3}$ of 240d. = $\frac{1}{3}$ **of £1.**

(2) Express 3 qt. 1 pt. as a fraction of 3 gal. 1 qt. 1 pt.

3 qt. 1 pt. = 7 pt.; 3 gal. 1 qt. 1 pt. = 13 qt. 1 pt. = 27 pt.

1 pt. = $\frac{1}{27}$ of 27 pt. ∴ 7 pt. = $\frac{7}{27}$ of 27 pt. i.e. 3 qt. 1 pt. = $\frac{7}{27}$ **of 3 gal. 1 qt. 1 pt.**

98. To express one compound number as a decimal of another compound number.

Example:—

Express £4 10s. $1\frac{1}{4}$d. as a decimal of £8 13s.

£4 10s. $1\frac{1}{4}$d. = 4325 farthings; £8 13s. = 8304 farthings, the fraction $\frac{4325}{8304}$ = ·52083$\dot{3}$.

∴ £4 10s. $1\frac{1}{4}$d. = **·52083$\dot{3}$ of £8 13s.**

99. To find the value of a fractional part of a compound number in terms of lower denomination.

Examples:—

(1) To find $\frac{3}{8}$ of £1:

$\frac{3}{8}$ of £1 = $\frac{3}{8}$ of 20s. = $\frac{3 \times 20}{8}$s. = $\frac{3 \cdot 5}{2}$s. = $1\frac{5}{2}$s. = $7\frac{1}{2}$s. = **7s. 6d.**

(2) Find the value of $\frac{7}{10}$ of a mile — $\frac{5}{8}$ of a fur. + $\frac{4}{11}$ of a po.

$\frac{7}{10}$ mile — $\frac{5}{8}$ fur. + $\frac{4}{11}$ po. = $\frac{7}{10}$ of 320 po. — $\frac{5}{8}$ of 40 po. + $\frac{4}{11}$ po.

= 224 po. — 25 po. + $\frac{4}{11}$ po. = $199\frac{4}{11}$ po.

Now $\frac{4}{11}$ po. = $\frac{4}{11}$ of $5\frac{1}{2}$ yd. = 2 yd.

and 199 po. = $\frac{199}{40}$ fur. = $4\frac{39}{40}$ fur. = 4 fur. + $\frac{39}{40}$ × 40 po. = 4 fur. 39 po.

∴ $199\frac{4}{11}$ po. = **4 fur. 39 po. 2 yd.**

100. To express a decimal fraction of a compound number in terms of a lower denomination.

Examples:—

(1) Find the value of ·765 of £1.

·765 of £1 = ·765 of 20s. = 15·3s.

·3s. = ·3 of 12d. = 3·6d.

∴ ·765 of £1 = **15s. $3\frac{3}{5}$d.**

Or we may work as follows—

(2) Find the value of ·28125 of £1.

£
·28125
20
5·625s.
12
7·5d.
4
2 farthings

∴ ·28125 of £1 = **5s. $7\frac{1}{2}$d.**

(3) Find the value of ·432 of 13s. 4d.

·432 of 13s. 4d. = ·432 of 160d.

d.
·432
160
69·12d.

69·12d. = **5s. $9\frac{3}{25}$d.**

(4) Find the value of ·34375 of a lunar month.

A lunar month = 28 days = 7 × 4 days.

days
·34375
7
2·40625
4
9·62500 days
24
15·00000 hours

∴ ·34375 of a lunar month = **9 days 15 hr.**

(5) Find the value of $\frac{7}{9}$ of $\frac{3}{14}$ of 3 acres — 2·00875 sq. yd. + ·02$\dot{2}\dot{7}$ of $3\frac{1}{2}$ sq. ft.

$\frac{7}{9}$ of $\frac{3}{14}$ of 3 acres = $\frac{1}{2}$ acre = $\frac{1}{2}$ × 4 ro. = 2 ro.

2·00875 sq. yd. = 2 sq. yd. + ·00875 × 9 sq. ft.

·00875 × 9 sq. ft. = ·07875 sq. ft. = ·07875 × 144 sq. in. = 11·34 sq. in. = $11\frac{17}{50}$ sq. in.

·02$\dot{2}\dot{5}$ of $3\frac{1}{2}$ sq. ft. = $\frac{225}{9999}$ of $\frac{7}{2}$ ft. = $\frac{225}{9999}$ × $\frac{7}{2}$ × 144 sq. in. = $\frac{126}{11}$ sq. in. = $11\frac{5}{11}$ sq. in.

2 ro. $11\frac{5}{11}$ sq. in. — 2 sq. yd. $11\frac{17}{50}$ in.

= **2 ro. 39 po. 28 sq. yd. 2 sq. ft.** $36\frac{63}{550}$ **sq. in.**

101. It is obvious that if for any measures or weights we use the **Metric System,** much labour is saved, for any number of a lower denomination can be expressed as a decimal of a higher denomination, and any number of a higher denomination can be expressed as a multiple of a lower denomination.

Examples:—

(1) Express 17432·5 metres in kilometres.

Since 1 kilometre = 1000 metres, we divide by 1000.

17432·5 m. ÷ 1000 = **17·4325 Km.**

(2) Find the value of $\frac{3}{4}$ of a kilogramme.

1 Kg. = 1000 g.

$\frac{3}{4}$ Kg. = $\frac{3}{4}$ of 1000 g. = $\frac{3000}{4}$ g. = **750 g.**

(3) Find the value of ·739 of 4 kilometres.

·739 × 4 Km. = 2·956 Km.

= **2 Km. 9 Hm. 5 Dm. 6 m.**

102. In most countries in Europe they have decimal coinage. In France, Belgium, and Switzerland sums of money are expressed in **Francs,** and $\frac{1}{100}$th part of a franc is called a **Centime.** In Spain the standard is about the same value as the franc, but is called a **Peseta.**

In Germany the standard coin is a **Mark,** and $\frac{1}{100}$th part of a mark is called a **Pfennig.**

In Austria the standard coin is a **Gulden, or Florin,** and $\frac{1}{100}$th part of a gulden is a **Kreutzer.**

In Italy the standard coin is a **Lira,** and $\frac{1}{100}$th part of a lira is a **Centesimo.**

In Norway, Sweden, and Denmark the standard coin is called a **Krone,** and $\frac{1}{100}$th part of a krone is called an **Ore.**

In Russia the standard coin is a **Rouble,** and $\frac{1}{100}$th part of a Rouble is called a **Copeck.**

In Holland the standard, as in Austria, is a **Gulden,** but $\frac{1}{100}$th part of a gulden is called a **Cent.**

In the United States of America the standard coin is a **Dollar,** and $\frac{1}{100}$th part of a dollar is called a **Cent.**

Other American States also reckon by dollars, but they are not of the same value as the U.S.A. dollar.

The approximate value of all these in terms of English money will be given in a later lesson.

In nearly all European countries the Metric System of weights and measures is adopted.

The student will find it convenient to remember the following:—

1 pint of water weighs ..	20 oz.
1 cubic foot of water weighs ..	1,000 oz.
1 cubic foot of water = ..	6·25 gallons.

Also that—

1760 yd. = ...	1 mile
5280 ft. = ...	1 mile
4840 sq. yd. = ...	1 acre
2240 lb. = ...	1 ton.

Exercise 33

Multiply—

(1) £7 19s. 7½d. separately by 10, 12, 19, 43, 107.
(2) £2579 0s. 0¾d. separately by 112, 474, 2331.
(3) 5 cwt. 1 qr. 14 lb. separately by 7, 15, 31.
(4) 3 yd. 2 ft. 10 in. separately by 10, 132, 475.
(5) 5 ac. 2 ro. 15 po. separately by 24, 97, 1052.
(6) 3 gal. 2 qt. 1 pt. separately by 40, 119, 273.
(7) 12 days 13 hr. 14 min. 12 sec. separately by 12, 27, 105.

Divide—

(8) £409 6s. 2d. by 8. (9) £3363 0s. 11¾d. by 528.
(10) 75 ac. 3 ro. 39 po. by 26.
(11) 178 cwt. 3 qr. 14 lb. by 53.
(12) 53 qr. 2 bush. 3 pk. by 107.
(13) £2586 15s. 4½d. by £26 13s. 4½d.
(14) 3 ac. 2 ro. 10 po. by 19 po.
(15) 61 tons 2 qr. 14 lb. by 4 cwt. 1 qr. 14 lb.
(16) 1 mile by 14 po. 3 yd.
(17) £20 10s. 7d. (i.) × $57\frac{1}{20}$; (ii.) ÷ $3\frac{3}{4}$.
(18) 27 yd. 1 ft. 7 in. (i.) × $\frac{3}{4}$ of $2\frac{2}{5}$; (ii.) ÷ $\frac{5}{8}$.
(19) £375 3s. × ·0507.
(20) £1558 4s. 2d. ÷ 1000.
(21) What fraction of £2 5s. is 7s. 6d. ?
(22) What fraction of 5 days 22 hr. is 7 hr. 6 min. ?

Key to Exercise 28

(1) 465·632$\dot{1}\dot{3}\dot{9}$. (2) 466·201715. (3) 7·27$\frac{1}{4}$, 28·92$\frac{7}{9}$, 3·1344799. (4) 4·6$\dot{9}$, ·377881, 1·0537$\frac{5}{7}$.
(5) 21·4047131, ·492954, 3·117511.
(6) ·$\dot{2}$, 1·443760, 617·919570, 1·896782.

Key to Exercise 29

(1) 976·39, 382394·56, 99·89.
(2) 2713694·72, 58839·46.
(3) 12·13, 2·06, ·63.
(4) 2·17, 9·17.

Key to Exercise 31

(1) 14283d., 3504d., 99d., 25200d.
(2) 450, 1056, 132, 1931 farthings.
(3) 1720, 9870 sixpences. (4) £796859 9s. 8¾d.
(5) 91301 gr.; 4 lb. 11 oz. 11 dwt. 4 gr.
(6) 4168327 dr.; 3497 tons 5 cwt. 1 qr. 24 lb. 2 oz. 6 dr.
(7) 21415 gills; 761 bush. 1 pk. 1 pt.
(8) 464437 in.; 1339 miles 7 fur. 28 po. 3 yd.
(9) 162246600[illegible] sq. in.; 159 ac. 1 ro. 29 sq. po. 14 sq. yd. 8 sq. ft. 11 sq. in.
(10) 884703 sec.; 74 days 15 hr. 54 min. 32 sec.

Key to Exercise 32

(1) £231 5s. 1¾d. (2) £3156 18s. 2d. (3) £1227 14s. 11¾d. (4) 640 miles 7 fur. 12 po. 1 ft. 7 in.
(5) 619 sq. m. 454 acres 21 po. 25 sq. yd. 4 sq. ft. 72 sq. in.
(6) £1 14s. 7½d.; £44 4s. 7½d.; £24 16s. 10¾d.
(7) 37 miles 3 fur. 15 po. 2 yd. 4 in.

M. A. L.

ALGEBRA.—XI

78. The statement of the equality of two algebraic expressions is called an equation. The two equal expressions are called the **sides** or **members** of the equation.

When the equality is true for *all* values of the operands, the equation is called **an identity.**

We shall first confine ourselves to expressions containing only one unknown quantity or variable. As a rule the letters x, y and z are used to indicate the variables, while other letters of the alphabet denote constants. We must first deal with equations in which the two sides are integral functions of the first degree in the variable. These are called **Simple Equations.**

The value or values of the variable for which the equation is true, are called the **roots.**

Two equations are said to be equivalent if they have the same roots.

To see how equations arise, it will be best to consider a concrete example:

A man has a number of loaves; if he gives a certain number to each of 12 people, he will have 2 loaves left, but if he gives the same number to each of 9 people he will have 8 loaves left. How many loaves did he intend to give each person?

Let the number of loaves he intends to give be x.

Considering the first case, we find the total number of loaves he has is $12x + 2$; and in the second case the total is $9x + 8$. These totals are the same, ∴ we have

$$12x + 2 = 9x + 8.$$

When we solve this equation, we find what value of x will reduce the equation to an identity.

77. *Theorem*: *If A and B are functions of the variable x, and m is a constant or any function of x which remains finite for all values of x in question, then the equations* $A = B$ .. .. .. (i)

and $A \pm m = B \pm m$ .. .. (ii)

are equivalent, where either both + signs or both − signs are taken.

If for any value of x, A = B, it follows that for that value of x, $A \pm m = B \pm m$. That is if any value of x makes (i) an identity, that same value of x will make (ii) an identity; and conversely.

Hence we conclude that **any term may be transferred from one side of an equation to another provided its sign be changed.**

For example: $a + b - c = d - e + f$ ... (i)

$\therefore (a + b - c) - (d - e + f)$
$= (d - e + f) - (d - e + f)$

$\therefore a + b - c - d + e - f = 0$ ..... (ii)

or again $a + b - c = d - e + f$.....(i)

$\therefore (a + b - c) + c + e = (d - e + f) + c + e$

$\therefore a + b + e = c + d + f$.....(ii)

Theorem: *If A and B be functions of x, and if r is a constant differing from zero, then the equations*

$A = B$..... (i)

$rA = rB$..... (ii)

are equivalent.

It is clear that if A = B, then $rA = rB$.

And conversely if $rA = rB$, where r is a constant differing from zero, then $rA - rB = 0$ $\therefore r(A - B) = 0$; and since $r \neq 0$ $\therefore$ A − B must = 0 and $\therefore$ A = B.

Since to divide by r is the same as multiplying by $\frac{1}{r}$, it follows that A = B, and $\frac{A}{r} = \frac{B}{r}$ are equivalent equations.

Returning to our equation

$12x + 2 = 9x + 8$..... (i)

$\therefore (12x + 2) - (9x + 2) = (9x + 8) - (9x + 2)$

$\therefore 3x = 6$

and dividing by 3, $\therefore x = \frac{6}{3} = 2$.

To test whether this root or solution is correct we substitute 2 for x in the original equation, which must then become an identity.

Examples:—

(1) Solve the equation

$$\frac{5x}{6} - 2 = \frac{3x}{4} - 4$$

Get rid of fractions by multiplying each term by 12, the L.C.M. of 4 and 6. Then

$10x - 24 = 9x - 48$

$(10x - 24) - (9x - 24) = (9x - 48) - (9x - 24)$

$x = -24$

(2) Solve the equation

$(x + a)(x + b) - (x - a)(x - b) = (a + b)^2$

Removing brackets, we have

$x^2 + (a + b)x + ab - x^2 + (a + b)x - ab = (a + b)^2$

$2(a + b)x = (a + b)^2$

dividing by coefficient of x,

$x = \frac{1}{2}(a + b)$

It is clear from the above that we proceed as follows: First clear the equation of fractions, then perform all algebraic operations indicated, and lastly collect all terms involving x on one side of the equation, and all constant terms on the other side.

Exercise 13

Solve the following equations:

(1) $5x + 50 = 4x + 56$. (2) $3x + 23 = 78 - 2x$.

(3) $7(x - 3) = 9(x + 1) - 3$. (4) $\frac{2x}{3} + 4 = \frac{7x}{12} + 9$.

(5) $x - [3 + \{x - (3 + x)\}] = 5$

(6) $(x + 1)(2x + 3) = 2(x + 1)^2 + 8$.

(7) $\frac{x}{5} + \frac{x}{15} + \frac{x}{20} = \frac{19}{60}$.

(8) $\frac{x - 1}{2} - \frac{x - 2}{3} + \frac{x - 3}{4} = \frac{2}{3}$.

(9) $\frac{x}{2} - \frac{x - 2}{3} = \frac{x + 3}{4} - \frac{2}{3}$.

(10) $(x + a)^4 (x - a)^4 - 8ax^3 + 8a^4 = 0$.

(11) $(a^2 + x)(b^2 + x) = (ab + x)^2$.

(12) $2{\cdot}25x - {\cdot}125 = 3x + 3{\cdot}75$.

78. Every Simple Equation may be reduced to the form $ax + b = 0$. Its solution is $x = -\frac{b}{a}$.

I. If $b = 0$ the equation is reduced to $x = 0$.

II. If $b = 0$ and also $a = 0$ the equation is satisfied for all values of x.

NOTE.—If $b = o$, $a = o$, then $\frac{b}{a} = \frac{o}{o}$. Yet o is not admissible as an ordinary algebraic operand, for it may lead to a contradiction. Suppose b is any finite quantity. Then if it be admissible to divide by o, $b \div o$ must = some finite quantity c.

i.e. $b \div o = c$..... (i)

$b \div o \times o = c \times o$..... (ii)

But if o be an ordinary operand, since division and multiplication are mutually inverse, $b \div o \times o$ must $= b$. On the other hand $c \times o = o$ since c is finite; hence we have from (ii) that $b = o$, i.e. a finite quantity $= o$, which is impossible. Hence o is not admissible as an ordinary operand.

III. If $b \neq 0$, and $a = 0$, then since $\frac{b}{o} = \infty$ the solution of the equation $ax + b = 0$ is infinite.

79. Suppose P and Q are functions of x, and that for some value of x, $PQ = O$.

Then if P be finite and not zero, $Q = O$.

And if Q be finite and not zero, $P = O$.

Hence we see that if P and Q be finite, either of the solutions $P = O$, $Q = O$ satisfies the equation $PQ = O$.

Thus the equation $x(x - 1) = 0$ is satisfied if either $x = 0$ or $x - 1 = 0$, i.e. $x = 1$.

Hence $x = 0$, $x = 1$ are the 2 roots of the equation.

Now consider the equations $P = Q$ .... I.

$RP = RQ$....II.

Where P and Q are finite functions of x and R is a constant or a function of x which is finite for all values of x which are solutions of I.

We have shown (77) that all solutions of $P = Q$ are solutions of $RP = RQ$, but as a rule the equations are not equivalent unless R is a constant.

Equation II. may be written $R(P - Q) = O$, and this is satisfied by the solutions $R = O$, $P = Q$. Thus we see that II. has the additional root or solution $R = O$.

For example let us take the equation $x - 1 = 1$. From this we derive $(x - 2)(x - 1) = (x - 2)$. Now this is satisfied by the solution of the original equation, namely $x = 2$, but it also has the additional solution $x = 1$, which clearly does not satisfy the original equation.

It follows from what has been said that when an equation is expressed in factors whose product equals zero, the roots of the equation can be seen by inspection.

Thus $(x - 1)(x + 2)(x - 5) = 0$ is clearly satisfied by the roots $x = 1, x = -2, x = 5$.

Again the equation $(x - a)(x - b)(x - c)\ldots = 0$ is satisfied if any one of its factors $= 0$, i.e. its roots are $x = a$, $x = b$, $x = c$.....

Hence **the solution of an equation resolves itself into finding the factors of an expression of the same degree as the equation.**

Example :—

$$x^3 - x^2 = 2x$$
$$x^3 - x^2 - 2x = 0$$
$$x(x^2 - x - 2) = 0$$
$$x(x + 1)(x - 2) = 0$$
$$\therefore x = 0, \text{ or } x = -1, \text{ or } x = 2.$$

80. An equation of the second degree is called a Quadratic Equation.

When all the terms of a quadratic equation are transposed to one side, it must be of the form $ax^2 + bx + c = 0$, where a, b, and c are known finite quantities.

To solve this equation we have to find the factors of $ax^2 + bx + c$.

We proceed as follows:

$$ax^2 + bx + c = 0$$

dividing by a, we have $x^2 + \frac{b}{a}x + \frac{c}{a} = 0$.

Now we complete the square of which the two terms in x are the two first terms, i.e. we add the square of half the coefficient of x, and then subtract it, so as not to invalidate the equation.

We then get $x^2 + \frac{b}{a}x + \left(\frac{b}{2a}\right)^2 - \left(\frac{b}{2a}\right)^2 + \frac{c}{a} = 0$

$$\therefore \left\{\left(x + \frac{b}{2a}\right)^2 - \left(\frac{b^2}{4a^2} - \frac{c}{a}\right)\right\} = 0$$

$$\therefore \left\{\left(x + \frac{b}{2a}\right)^2 - \frac{b^2 - 4ac}{4a^2}\right\} = 0$$

$$\therefore \left\{\left(x + \frac{b}{2a}\right)^2 - \left(\sqrt{\frac{b^2 - 4ac}{4a^2}}\right)^2\right\} = 0$$

Having reduced the expression on the left to the form of the difference of two squares, we can factorize it.

Hence $\left\{x + \frac{b}{2a} - \sqrt{\frac{b^2 - 4ac}{4a^2}}\right\}$

$$\left\{x + \frac{b}{2a} + \sqrt{\frac{b^2 - 4ac}{4a^2}}\right\} = 0$$

Hence either $x + \frac{b}{2a} - \sqrt{\frac{b^2 - 4ac}{4a^2}} = 0$ or

$$x + \frac{b}{2a} + \sqrt{\frac{b^2 - 4ac}{4a^2}} = 0$$

Thus there are two roots

$$x = -\frac{b}{2a} - \sqrt{\frac{b^2 - 4ac}{4a^2}} \text{ and}$$

$$x = -\frac{b}{2a} + \sqrt{\frac{b^2 - 4ac}{4a^2}}$$

These may be written in the more convenient form $x = -\frac{b \pm \sqrt{b^2 - 4ac}}{2a}$

Examples :—

(1) Solve $x^2 - 13x + 30 = 0$.

$$x^2 - 13x + \left(\frac{13}{2}\right)^2 - \left(\frac{13}{2}\right)^2 + 30 = 0$$

$$\therefore \left(x - \frac{13}{2}\right)^2 - \frac{169 - 120}{4} = 0$$

$$\therefore \left(x - \frac{13}{2}\right)^2 - \left(\frac{7}{2}\right)^2 = 0$$

$$\therefore \left(x - \frac{13}{2} - \frac{7}{2}\right)\left(x - \frac{13}{2} + \frac{7}{2}\right) = 0$$

$$\therefore x = 10 \text{ or } x = 3$$

(2) Solve $6x^2 + 7x = 73$

$$6x^2 + 7x - 73 = 0$$

$$\therefore x^2 + \frac{7}{6}x - \frac{73}{6} = 0$$

$$\therefore x^2 + \frac{7}{6}x + \left(\frac{7}{12}\right)^2 - \left(\frac{7}{12}\right)^2 - \frac{73}{6} = 0$$

$$\therefore \left(x + \frac{7}{12}\right)^2 - \frac{1801}{144} = 0$$

$$\therefore \left(x + \frac{7}{12} - \frac{\sqrt{1801}}{12}\right)\left(x + \frac{7}{12} + \frac{\sqrt{1801}}{12}\right) = 0$$

$$\therefore x = -\frac{1}{12}\left(7 - \sqrt{1801}\right) \text{ or } -\frac{1}{12}\left(7 + \sqrt{1801}\right)$$

$$\therefore x = -\frac{1}{12} \times \left(-35{\cdot}44\right) \text{or } x = -\frac{1}{12} \times 49{\cdot}44.$$

$\therefore x = 2{\cdot}95$ or $x = -4{\cdot}12$ to two places of decimals.

(3) Solve $(b - c)x^2 + (c - a)x + (a - b) = 0$ divide by $(b - c)$

Then $x^2 + \left(\frac{c - a}{b - c}\right)x + \frac{a - b}{b - c} = 0$

$$\therefore x^2 + \left(\frac{c - a}{b - c}\right)x + \left\{\frac{c - a}{2(b - c)}\right\}^2 - \left\{\frac{c - a}{2(b - c)}\right\}^2 + \frac{a - b}{b - c} = 0$$

$$\therefore \left\{x + \frac{c - a}{2(b - c)}\right\}^2 - \frac{c^2 - 2ac + a^2 - 4ab + 4ac + 4b^2 - 4bc}{4(b - c)^2} = 0$$

$$\therefore \left\{x + \frac{c - a}{2(b - c)}\right\}^2 - \left\{\frac{c + a - 2b}{2(b - c)}\right\}^2 = 0$$

$$\therefore x + \frac{c - a}{2(b - c)} + \frac{c + a - 2b}{2(b - c)} = 0$$

$$\text{or } x + \frac{c - a}{2(b - c)} - \frac{c + a - 2b}{2(b - c)} = 0$$

$$\therefore\ x - 1 = 0 \text{ or } x - \frac{a-b}{b-c} = 0$$

$$\therefore x = 1 \text{ or } x = \frac{a-b}{b-c}$$

When thoroughly familiar with this process the student may write down the roots from the formula thus, $5x^2 + 14x = 55$

$$\therefore 5x^2 + 14x - 55 = 0$$

then $\left(\text{since } x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}\right)$,

$$x = \frac{-14 \pm \sqrt{196 + 1100}}{10}$$

$$x = \frac{-14 \pm 36}{10}$$

$$\therefore x = -5 \text{ or } x = \frac{11}{5}$$

Whenever possible, the factors should be found by inspection, as this saves much trouble.

Exercise 14

Solve the following equations—

(1) $x^2 + 24x = 25$. (2) $x^2 - 5x - 36 = 0$
(3) $68 - x^2 = 13x$. (4) $8x^2 + x = 30$
(5) $22 - 6x^2 + x = 0$. (6) $19x = 15 - 8x^2$.
(7) $x^2 + x = b^2 + b$. (8) $(a - x)^3 + (x - b)^3 = (a - b)^3$.

Key to Exercise 11

(1) xy. (2) a^2bcd^2. (3) $x - 1$. (4) $2x - y$.
(5) $x^4 + x^2 + 1$. (7) $14x^2y^2z^3$. (8) $(x + 1)^2 (x - 1)^2 (x^2 + x + 1)$. (9) $(a - b)(4a - b)(3a^2 + b^2)$.
(10) $(3x + 2)(8x^3 + 27)(8x^3 - 27)$.
(11) $x^8 + x^4 + 1$.

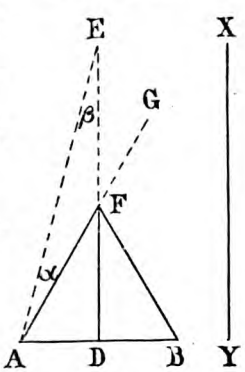
M. A. L.

GEOMETRY.—X

Proposition 55. Problem

Construct an isosceles triangle having given the base, and the sum of one of the equal sides and the perpendicular from the vertex to the base.

Let A B be the given base, and X Y the sum of one of the equal sides and the ⊥ from the vertex on A B.



Bisect A B at D (Prop. 20).

At D draw a line ⊥ to A B, making D E = X Y (Prop. 21).

Join A E.

At pt. A in the str. line E A make ∠ E A G = ∠ D E A (Prop. 18).

Let A G cut D E at F.

Join F B.

Then A F B is the required △.

Proof.—In △s A F D, B F D.

A D = B D (construction).

D F is common,

included ∠ A D F = included ∠ B D F (rt. ∠s).

∴ △ A F D ≡ △ B F D (Prop. 5).

∴ A F = B F.

i.e. △ A F B is isosceles.

In △ F E A, α = β (construction).

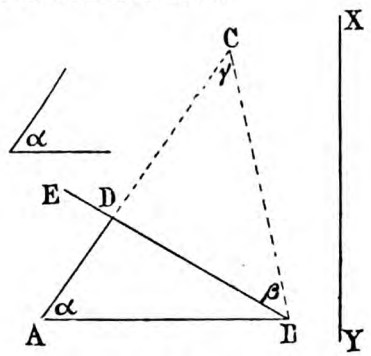
∴ F A = F E (Prop. 7).

∴ F A + F D = F E + F D = D E = X Y.

Proposition 56. Problem

Construct a triangle having given the base, one of the angles at the base, and the sum of the sides.

Let A B be the given base, and α the given ∠ and X Y the sum of the sides.



At pt. A in str. line B A make an ∠ B A C = α, and make A C = X Y (Prop. 18).

Join C B.

At pt. B in the str. line C B make an ∠ C B E = ∠ γ and let B E cut A C at D.

Then A D B is the required △.

Proof.—In △ C B D, β = γ (construction).

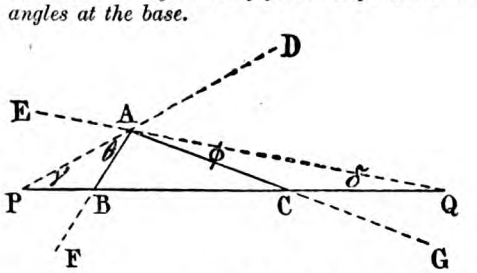
∴ D B = D C (Prop. 7).

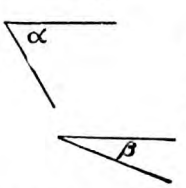
∴ A D + D B = A D + D C = A C = X Y (construction).

Also the △ is on the given base A B, and has the ∠ B A D = given ∠ α.

Proposition 57. Problem

Construct a triangle having given the perimeter and the angles at the base.





Let P Q be the given perimeter and α and β the ∠s at the base.

At pt. P in str. line Q P, make ∠ Q P D = ½ ∠ α, and at pt. Q make ∠ P Q E = ½ ∠ β (Prop. 18).

Let P D and Q E cut at A.

At pt. A in str. line P A make ∠ P A F = γ (Prop. 18), and at pt. A in str. line Q A make ∠ Q A G = δ (Prop. 18).

Let A F cut P Q at B, and A G cut P Q at C.

Then A B C is the required △.

Proof.—In △ B P A, $\gamma = \theta$ (construction)
∴ A B = P B (Prop. 7).
Similarly A C = Q C.
∴ A B + B C + C A = P B + B C + C Q
= P Q,
i.e. the perimeter of A B C = P Q.
Again, ∠ A B C = $\gamma + \theta$ (ext. ∠ of △ A B P—Prop. 4, Cor. 3)
= 2 γ
= α.
Similarly ∠ A C B = β.

Proposition 58. Problem

To divide a given straight line into a given number of equal parts.

Let A B be the given str. line, which is to be divided into any number (say 5) equal parts.

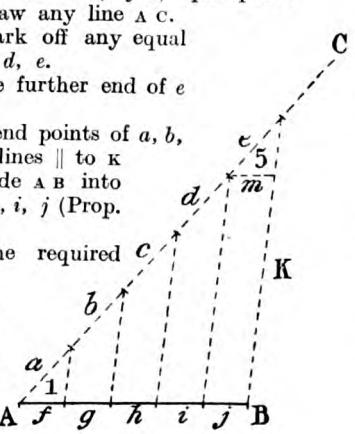
Through A draw any line A C.

Along A C mark off any equal lengths, *a*, *b*, *c*, *d*, *e*.

Join B to the further end of *e* by the line K.

Through the end points of *a*, *b*, *c*, *d* draw str. lines ‖ to K which will divide A B into the parts *f*, *g*, *h*, *i*, *j* (Prop. 29).

These are the required equal parts.

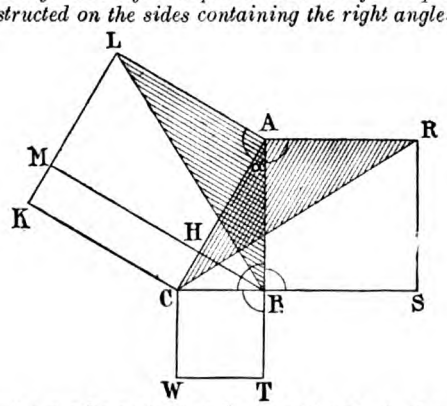


Proof.—Through the lower end of *e* draw a line ‖ to A B cutting K so as to form the △ 5 (Prop 29).

In △s 1 and 5,
2 ∠s of 1 = corresponding ∠s of 5 (Prop. 26)
side *a* = side *e* (construction).
∴ △ 1 ≡ △ 5 (Prop. 9).
∴ *f* = *m*.
But *m* = *j* (opp. sides of a ▱—Prop. 31).
∴ *f* = *j*.
Similarly *f* = *g* = *h* = *i*.

Proposition 59. Theorem

The square constructed on the hypotenuse of a right angled triangle is equal to the sum of the squares constructed on the sides containing the right angle.



Let A B C be a rt. ∠ △ having the rt. ∠ at B.
On A B, B C, C A construct the squares B R, C T, A K.

It is required to prove that A K = B R + C T.

Proof.—A B S and A B C are rt. ∠s.
∴ C B S is a str. line. (Prop. 2.)
C B T and C B A are rt. ∠s.
∴ A B T is a str. line. (Prop. 2.)
Draw a line through B ‖ to A L or C K, cutting A C at H and L K at M. (Prop. 29.)
Join B L, C R.
△ A C R is on same base A R as sq. B R and it has the same height, A B
∴ △ A C R = ½ area of B R. (Prop. 35.)
△ A B L is on same base A L as rect. A M and it has the same height, A H
∴ △ A C R = ½ area of A M. (Prop. 35.)
Now ∠ C A R = α + 1 rt. ∠
and ∠ L A B = α + 1 rt. ∠
∴ ∠ C A R = ∠ L A B
In △s C A R, L A B
C A = L A
A R = A B } (sides of a sq.).
included ∠ C A R = included ∠ L A B
∴ △ C A R ≡ △ L A B. (Prop. 5.)
∴ B R which = twice △ C A R
= A M which = twice △ L A B.
Similarly, by joining B K and A W we may show that K H = C T
∴ A M + K H = B R + C T.
i.e. A K = B R + C T.

The above theorem is called the theorem of Pythagoras after the philosopher who discovered it.

Exercise 12

1. Prove that the perpendiculars drawn to the sides of an equilateral triangle from the opposite angular points are equal.

2. In any quadrilateral, (1) the straight line joining the middle points of two adjacent sides is parallel to a diagonal and equal to half of it. (2) The figure formed by joining the middle points of the sides in order is a parallelogram. (3) The straight lines joining the middle points of opposite sides bisect one another.

3. If the squares on the sides A B, C D of a quadrilateral A B C D, together equal the squares on B C, D A, prove that the diagonals A C, B D intersect at right angles.

4. If the square on one side of a triangle be greater than the sum of the squares on the other two sides, prove that the angle contained by those two sides is an obtuse angle.

Exercise 13

1. Given a = 19·3 cm., b = 44·8 cm. calculate c.
2. Given c = 65 in., a = 63 in. find b.
3. Two roads cut at right angles. From the corner where they cross A bicycles 7 miles along one road while B motors 24 miles along the other. How far are A and B then apart?
4. The square described on the diagonal of a given square is double of the given square.
5. A B C is a triangle having a right angle at A. If E and F are the middle points of A C and A B, prove that the sum of the squares on B E, C F is equal to five times the square on E F.
6. If B C be the hypotenuse of a right-angled triangle A B C, and B E be the square described on B C, and A K the square described on A C (outside the triangle), show that A E and B K intersect at right angles.

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Continued from page 115.

ART AND MUSIC:

***Contributors*:**—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).

DRAWING.—VIII

SHADOWS are of two kinds: those cast by artificial light and those cast by sunlight. Taking the former first, it is worth while explaining these, classifying them as 1 and 2.

(1) This is illustrated by Fig. 33, which represents two drawing-boards or flat pieces of cardboard placed at right-angles to each other. Practise this experiment in a dark room, as it is important that you should have one source of light only. Let this be a candle, as in the diagram. Now take a smaller board, and hold it vertically before the upright board upon which its shadow will now be cast when you hold it between the upright board and the candle. The four corners of the shadow are *a b c d*, and from these imaginary straight lines can be drawn which terminate at the flame of the candle—the source of light. This

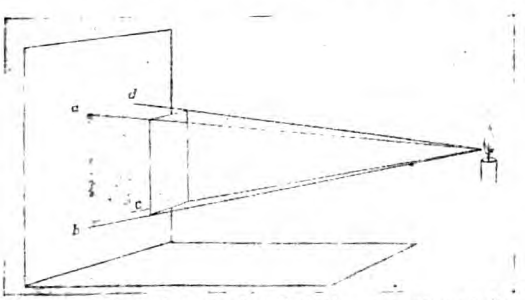


Fig. 33.—Experiment showing the nature and behaviour of shadows cast by artificial light.

remains the case at whatever angle you hold the loose cardboard.

From this you can derive a maxim to be remembered: The shadow always falls immediately behind the object and along the straight line joining the object with the source of light.

Now, leaving everything else alone, move your object-board near the light. The points of the shadow remain as they were before, only the shadow is larger, and there will be their differences to notice as well: the edges of the shadow will be much vaguer, and its tone will be lighter. The nearer you bring the loose card to the source of light, the more obvious will these differences become

Now place the lower edge of your loose board upon the board that is lying on the table, and let it rest there. A shadow will now be cast along the ground, that is, along the lower board, as the stream of light has been interrupted. The darkness of the shadow just beneath your loose or object-board will be intense, but will grow less and less until it reaches the vertical shadow which climbs up the upright board. This latter will be of the same tone practically throughout. The shadow broadens as it advances across the lower board (or horizontal plane) because, as shown above, the

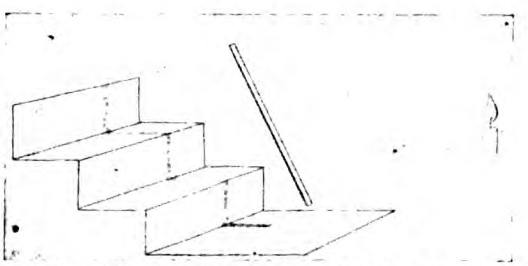


Fig. 34.—Showing that the shape of a shadow varies according to the surface on which it is cast.

surfaces which receive the shadow get farther and farther away from the object.

Now take a sheet of fairly thin cardboard and, whilst regarding it as the upright sheet board of your experiment, bend it into some shape—say a set of four or five steps. Now hold a pencil or a poker or ruler so that the shadow of it falls upon this shape, and you will see that the shadow bends just as the surface bends, going up the steps and along their tops and up again. So that you may take it as an invariable rule that the shape of a shadow will vary according to the surface on which it is thrown (Fig. 34). Vary this experiment in any way that occurs to you. Bend your sheet of cardboard into any shape that takes your fancy, and hold before it any object not too big to have its shadow contained by the cardboard surface.

(2) We now come to those shadows which are cast by sunlight.

Taking Fig. 33 as our illustration still, withdraw the light to a considerable distance. You will then see that the lines drawn from the corners of the object to the corners of its shadow are more near to a parallel. The farther you withdraw the

source of light, the less the shadow will grow. Now, the sun is so far from any object on the earth that the rays from it can be reckoned to pass through the corners of the object, such as *a b c d* in Fig. 33, parallel to each other. So that if you try to follow the experiment pictured in Fig. 33, you will fail. Try it, nevertheless. Hold your object-board in the direct sunlight, and move it backwards and forwards, to and from the upright board. You will find that the shadow remains the same size, wherever you hold it.

When you wish to draw a particular object or group of objects, getting the shadows accurate, you are hampered out of doors by the difficulty of the moving sun—or, rather, the earth moving in relation to the sun. So you should do your drawing in a room lit by one window, and that not in the direct path of the sun. This is why artists require a studio with a north light. The shadows in this way remain for the longest possible time the same. All things considered it is better to practise shading in the first instance by artificial light.

A Useful Experiment

The following is an experiment which teaches a useful lesson. Hold side by side two squares of white board of the same size, let them be perpendicular and in the light of the sun or a candle. Now let one of these fall slowly back, away from the light. As it drops compare the intensity of light upon it with that on the board you are still holding upright. The latter will be much brighter. For the strength of light on an object depends on the angle at which it falls on that object.

Before going on to further exercises in shading a few comments on materials will not be out of place. Reference has already been made to *stumps*, which are sometimes made of leather besides French grey paper. The leather ones give the smoother effect.

The stump is held rather differently from a pencil or pen. Being short, the end of it not in use comes under the palm of the hand. If you hold a long pencil in the ordinary way you cannot get a very broad stroke, because after a time it rests between your thumb and first finger, and you cannot lower it further, save by holding the pencil at a long distance from its point ; and this makes you lose power over it. By holding the stump loosely under your hand (and its shortness prevents the end of it knocking against your palm or wrist), you have perfectly free play. As you draw it over the paper, let the stump revolve slowly so that all parts of its point do their fair share of work and become equally worn down.

Stumping *chalk*, which can be bought of any artists' colourman, is usually obtained in little bottles. You should make a sort of palette for it by pinning a small piece of spare paper at a convenient place on the right side of your drawing-board. Fold up the under edge of this so that it catches any loose grains of chalk and prevents them from falling on your drawing. On this " palette " rub a little of the chalk with the cork of your bottle, then you can dip the end of your stump into it as required.

If you are going to shade a drawing with a stump, do not use an ordinary pencil for the outline, but use charcoal instead. This can be bought in small sticks. They are very brittle, so considerable care must be used in drawing with them. Do not press hard on your charcoal. A lightly drawn line is very easily erased. You can use india-rubber for removing chalk lines, but it is much better to use bread. This should not be quite new, as new bread is moist. Very stale bread is too liable to crumble.

You should now practise the use of your materials in the exercises that follow.

In the first place take a sheet of French white paper. This is much rougher than ordinary cartridge paper. Ridges parallel to each other run across the surface, and even to the naked eye the paper seems to be covered with a regular succession of hills and dales. Cut this sheet up into four equal pieces.

The Art of Shading

Now take your charcoal and draw a rectangle on one of these pieces, then proceed to chalk it over with your stump. Begin at the top left-hand corner and work gradually down. Do not employ flat straight lines, but little curled lines something like the letter Z. Finish each Z separately, and leave a small space between each. As you work down the paper these spaces should be considerably decreased, until at the bottom your Z's come close together in almost solid formation. Make the Z strokes on a scattered and irregular plan, not in horizontal lines. And bear in mind that your stump should be kept constantly moving round. When you need more chalk, roll the end of the stump lightly in the supply you have arranged on the spare piece of paper. Until you have thoroughly practised this exercise, you will find that now and again a black spot appears from undue pressure on the stump, or an uneven and too generous supply of chalk. This may be removed by the careful use of bread. A smooth tone throughout the rectangle will come with practice. (Fig. 35.) As in all other branches of drawing, avoid haste. It is always worth while to take your time and to do your exercise deliberately.

Now turn to Fig. 36, and with another piece of paper draw your second rectangle. This time make all your strokes nearer together, and at one end of the rectangle use a little more chalk. This has the effect of producing a darker tone. You can regulate the depth or lightness of tint by regulating the supply of chalk on your stump.

Your third piece of paper should now be devoted

From a sketch by John MacWhirter, R.A.

STUDY OF SKY, DUMFRIESSHIRE.

From a sketch by John MacWhirter, R.A.

NEAR LAKE OF CONSTANCE, SWITZERLAND.

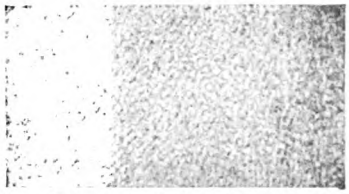


Fig. 35.—An even tone.

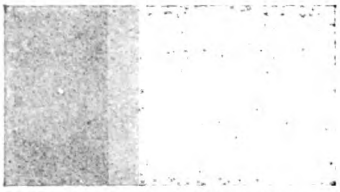


Fig. 36.—Dark and light tones.

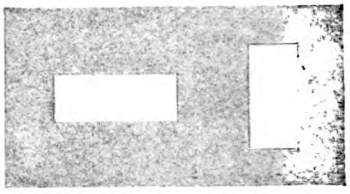
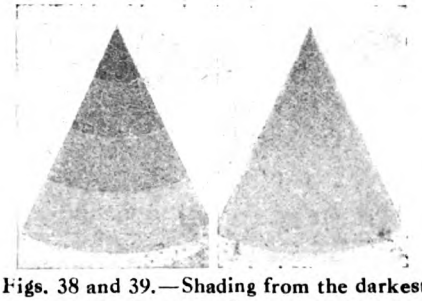


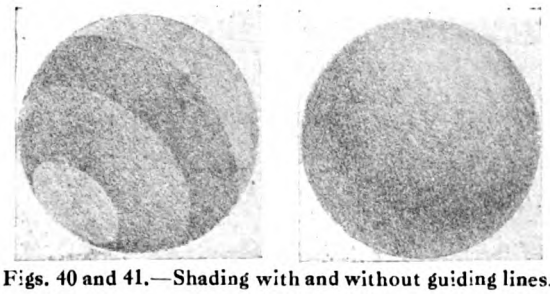
Fig. 37.—Shading accurate edges.

to Fig. 37. Draw your large rectangle, containing two smaller ones, or more if you prefer it, and surround these with a smooth and even tint. This exercise is for practice in bringing the tinted portion accurately up to the edges of smaller forms. It will teach you how to make clean edges to your shadows in subsequent and more complicated drawings. You can never practise this exercise too often, for it is a very important one.

Fig. 42 shows how you may practise the same shading up to a circular outline. Notice that in this instance a different method is employed. Straight lines are used in place of the small Z strokes. Do not, if you employ this means, allow the lines to appear *as* lines, but bring them (each broad in itself) so close together as to make an even tint. This method is far from satisfactory, however, and often produces an untidy effect. You may improve it by cross-hatching sometimes. But the Z stroke is greatly to be preferred.



Figs. 38 and 39.—Shading from the darkest tint to the lightest.



Figs. 40 and 41.—Shading with and without guiding lines.

The next lesson to learn deals with the *gradation* of tints. As before, take four small pieces of paper and devote each to a particular exercise. Fig. 43 shows a rectangle divided up into four equal pieces. With your stump, cover these with tint, beginning lightly with the first and gradually increasing the amount of chalk until the fourth is reached, which is quite dark. In the next exercise (Fig. 44) you do the same thing only in one piece. Begin with a light tint and work up to a dark one, all in the same rectangle.

You may possibly think that it is unnecessary to have so many separate exercises for what is, in a sense, the same lesson. But if you carefully divide each lesson and each truth in the art of drawing into as many possible sub-headings, and master each separately, you will find yourself in a position to understand the whole far sooner than if you "telescoped" two or three lessons into one. Figs. 38 and 39 show how the above exercise may be used with the sector of a circle instead of a rectangle. In these exercises reverse the order, and beginning with the darkest tint work down to the lightest. This reversal of method is in itself a very useful thing to practise. If you find, as you come towards the lighter parts, that you have too much chalk on your stump, rub a little off on your spare paper.

A further valuable exercise is made by dividing a rectangle with perpendicular lines. In this case make the middle division dark and let the sides grow lighter. After you have tinted the middle division, do those next to it on either side and then the outer divisions. Then do the same thing without the help of divisions. In that case you should make a faint line down the middle as your guide. You should begin at the top of this line on one side of your centre line and work down to the bottom. Then go on to the other side, allowing your guiding line to become obliterated. Then left and right get your tone lighter and lighter until you reach the edges.

When you have practised this, copy Figs. 40 and 41, which are on the same principle but within a circle. The guiding lines in Fig. 40 should be absolutely correct curves.

J. G. B. L.

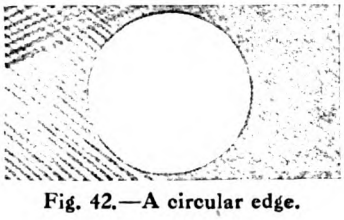


Fig. 42.—A circular edge.

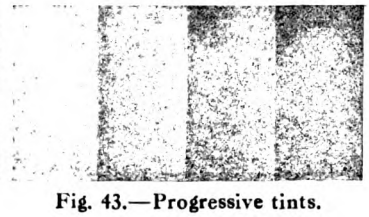


Fig. 43.—Progressive tints.

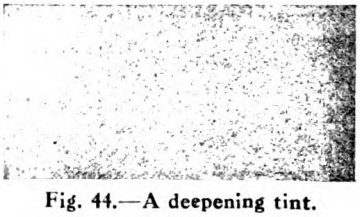


Fig. 44.—A deepening tint.

Continued from page 120.

BUSINESS AND COMMERCE:

Contributors:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).

COMMERCIAL TRAINING.—X

BANKING plays a supremely important part in the world of commerce. To the business man a bank is far more than a depository for money and securities, for the business of banking embraces not only the handling of cash and the clearing of cheques, but also the discounting of bills, the lending of money upon approved security, the transmission of funds abroad, and the holding of money or securities upon deposit. Incidentally, one may ascertain through one's bank manager the financial standing of an individual or company in which one is interested.

In these days the majority of banks come under the heading "Joint Stock Banks." That is to say, they are companies owned by shareholders and managed by boards of directors. There are very few privately owned banks remaining. The joint stock banks, which have branches scattered far and wide, are managed broadly from their Head Offices; and with most of them one may pay in money at the Head Office or at either of the branches to be credited to one's account at a particular branch.

Banking Accounts

Banking accounts are of two types, deposit and current. With a deposit account the funds are not available for withdrawal by cheque at will, but stand in the account "on deposit" and earn interest. In the ordinary way money in a deposit account is only withdrawable at seven days' notice, but in some circumstances where an amount is lodged for a definite term much longer notice is required. Thus, an amount may be on deposit subject to six months' notice or three months' notice; and in some cases the longer the notice the higher the rate of interest payable.

In any newspaper you will find in the business columns the Bank Rate of the day, or rather of the week, for the rate is always liable to fluctuation. This is the rate fixed by the Bank of England for granting loans or discounting bills of exchange. Upon the prevailing Bank Rate joint stock banks base the amount of interest they pay upon their deposit accounts, the actual interest varying slightly between Metropolitan branches of banks and those situated in the provinces.

Seeing that banks do not pay interest on money standing in a current account, it will be obvious that when a business man has a lump sum by him that he wishes neither to use at once nor to invest he transfers it to a deposit account; in other words, he lends the amount to his bankers at the rate of interest of the day, knowing that directly he requires to make use of the sum in his business he can obtain it at short notice.

Cheque Books

The current account is a totally different proposition from the deposit account. It has already been explained that no interest is payable by the bank on a current account, and the amount standing to the credit of this account is employed to meet the charges of cheques issued by the customer from time to time. In other words, the current account is the cash box or till of the business man.

It is quite obvious that every business man must have a banking account not only for the purpose of having his money safely stored, but also for the facility of issuing cheques to pay for goods received and for the clearance of cheques paid to him. To open a banking account one must have beyond the initial sum of money required an introduction from someone who is either known personally to the bank or about whom enquiries may be freely made. It is not sufficient merely to go to a bank with a bag of cash or a roll of notes and to ask to become one of the bank's customers. Introductions are of great importance, for banks take particular care in pursuing inquiries.

Having signed the register and completed

the formalities of the manager's office the prospective customer will receive from one of the cashiers, or a clerk, a cheque book. No charge will be made for this book, except that the Government Duty of twopence for the stamp on each cheque will be charged to the customer's account. Cheques are issued usually in books of 25, 50 and 100 cheques.

The cheques are numbered consecutively, the sequence of numbers entered in the records of the bank in the name of the customer. But, besides the actual cheque in the book, there is for each a counterfoil, and upon this counterfoil is noted down the name of the recipient of the cheque, the date when it was drawn, and the amount, whilst sometimes little private notes as to the purpose of the cheque are jotted down, such as "Rent," "For Materials," etc., etc.

Bearer and *Order*

In present-day banking practice, it should be noted, there are two classes of cheques, those made payable to the person named, "or Bearer," and those payable to the person (or firm) named, "or Order." The former is termed a "Bearer" cheque; the latter a cheque "to Order." A Bearer cheque may be cashed over the counter of the bank and branch at which it is payable, and it requires no endorsement at the back. An Order cheque may also be cashed over the counter, unless it be crossed & Co., but it requires an endorsement; in other words, the amount will not be paid without the signature of the prospective recipient on the back of the actual draft.

In most cases when drawing a cheque for business purposes it is usual to use an Order cheque, and to cross it & Co. When a cheque is crossed it cannot be paid over the counter of a bank, but must be paid into one's banking account in order to be cleared or collected from the bank of issue. When a cheque is marked a/c Payee it can only be cleared through the banking account of the payee. In any case, no crossed cheque may be cashed over the counter, but must be cleared through a bank. Naturally a cheque on the particular branch of a bank at which the payee has an account, as well as the drawer, may be paid into that bank in the ordinary way, but it cannot be converted into cash; it must first be credited to the payee's account.

In most modern offices the cashiers have in operation a simple little machine which marks by means of a series of non-erasable strokes the words NOT OVER TEN POUNDS £10£, or whatever the particular amount may be. These little machines generally begin their amounts at £1£, and then proceed £2£, £3£, £4£, £5£, £6£, £8£, £10£, £12£, £15£, £20£, £25£, and so on through the tens. The object is to limit the chance of the amount on the cheque being improperly increased. In the case of private accounts when drawing small cheques it is a good plan to write beneath the figures of the amount: Not over Two Pounds, or Not over One Pound, as the case may be.

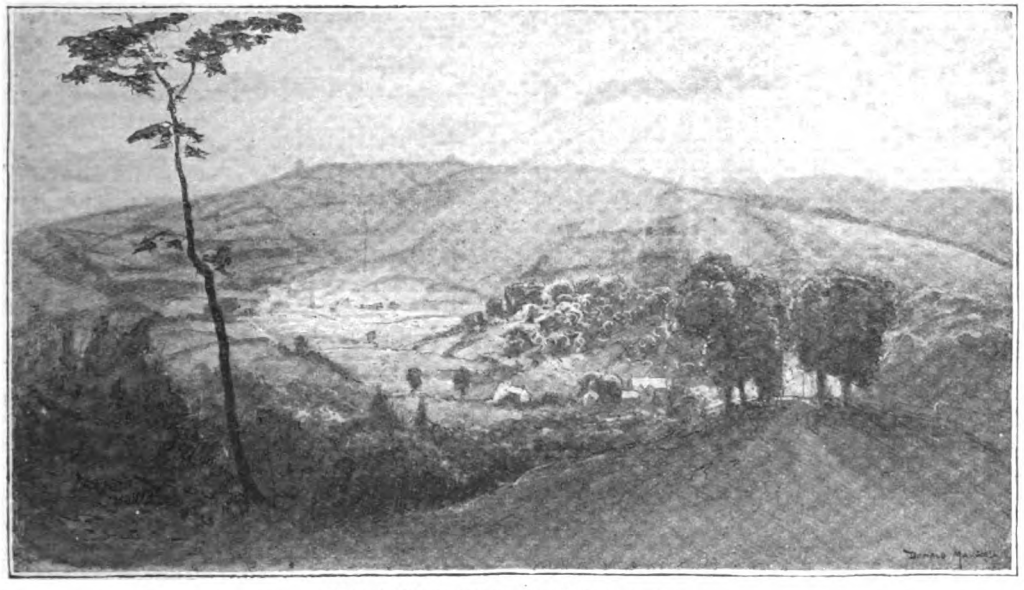
Many firms print at the head of their invoice forms the name of their bankers, and sometimes one sees the phrase: Cheques should be made payable to—— and crossed "London County and Middlesex Bank, Ltd.', In such cases, where the lines & Co. come, one should write in the name of the bank mentioned, and the branch when it is specified. In other instances one will observe on invoices in addition a/c Payees or Payee, and if this is the case the words should be added below the title of the bank.

The Individual's Endorsement

When a cheque, after being presented at a bank, is paid through to the bank of issue, the cashier there ascertains if there are sufficient funds in the account to meet it, and checks the signature if it is at all in doubt. Then, if all is clear, he accepts the draft and credits the presenting bank with the amount. Should there be an irregularity, however, he does not accept the cheque, and it is sent back to the presenting bank.

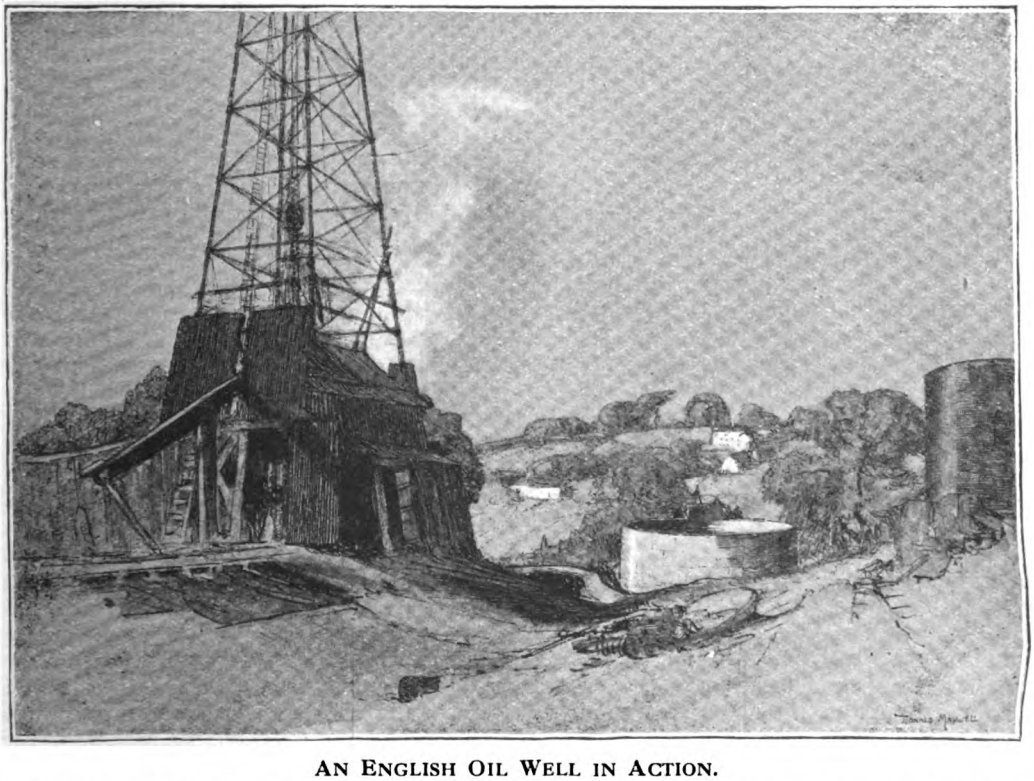
In banking practice, more cheques are returned for irregularity of endorsement than for any other cause, and over this matter too much care cannot be exercised. For example, if a cheque made payable to John Ewart were endorsed J. Ewart the endorsement would be irregular and the cheque would be returned. In all cases where cheques are made payable to individuals the endorsement *must* exactly correspond with the title of the payee in the cheque. Because in drawing a cheque a person's signature is John Ewart it does not follow that he should use this signature when endorsing a cheque unless it be made payable to John Ewart. If the cheque were drawn to the old-fashioned Jno. Ewart, the endorsement should be Jno. Ewart.

A. B.



NEAR MATLOCK, IN DERBYSHIRE,

one of the many spots where recent investigation has led to the discovery of oil. The site of the boring can be seen where light is striking on the left of the picture.



AN ENGLISH OIL WELL IN ACTION.

The works at Hardstoft, where a "gush" of 400 gallons a day is maintained. But much oil will be required to counterbalance the decline in Britain's output of coal.

CHOOSING A CAREER.—XI

In these days of advanced education when girls and boys remain at Council Schools until they are sixteen, with encouragement to stay on till eighteen, it will be easily understood that the old class of Civil Servant, the Temporary Boy Clerk, is no longer being recruited and that open competitive examinations for this type of candidate are no longer held.

There is, however, an Abstractor Class of Assistant Clerks, with age limits of seventeen and eighteen, but no candidate is eligible who has not figured on the register of Boy Clerks.

A Reorganised Civil Service

As a matter of fact, the latest proposal is to abandon altogether not only the Boy Clerks, but also the Second Division Clerks, and to substitute for them two new classes of permanent Civil Servants, to be called the Senior and Junior Clerical Class. We should thus have in the Civil Service the Class 1 Clerks, drawn from young men who have been educated at public school and university; the Senior Clerical Class, recruited from lads of public school education who did not go on to the university; and the Junior Clerical Class, to be drawn from boys of secondary school education.

On all these matters, however, it is highly advisable for the would-be applicant to write direct to the *Secretary, Civil Service Commission, Burlington Gardens, London, W.* 1, for copies of the latest regulations in force. It may be mentioned also that the most complete details of examination papers and similar matters are given in the "Civil Service Year Book," which is issued in the early part of each year by *Messrs. The Clerkenwell Press, Ltd., of* 76 *Clerkenwell Road, London, E.C.*

It would be well also to explain broadly the system of recruiting for the various classes of Civil Servant. On the one hand, we have the Admiralty, the War Office, Board of Inland Revenue, Home Office, Board of Health, Board of Trade, Crown Agents for the Colonies, Ecclesiastical Commission, Board of Agriculture and all the other Government departments.

The personnel of their establishments is definitely laid down, and as vacancies occur the heads of departments make application to the Civil Service Commission.

On the other hand, the Civil Service Commission, anticipating these vacancies, will have conducted its examinations and have ready a list of suitable candidates from which the names of those to fill the new posts will be drawn.

Thus (except in unusual cases) one may only approach the Civil Service broadly and not in detail. For instance, the candidate is not able to specify that he wishes employment in the War Office; and, should he prove successful in the examinations, it is quite as likely that he may find himself in a draft for the Admiralty.

Excluding the Post Office service, which will be amply dealt with in a future lesson, female typists are employed in some of the Government departments. The age limits are eighteen and thirty, and the subjects of examination include writing, spelling, English composition, copying manuscript, arithmetic (first four rules, simple and compound, including English weights and measures, and reduction), typewriting and shorthand, though the latter subject is in certain departments dispensed with.

The examinations are held in London, Dublin, Edinburgh and certain other cities.

Civil Service appointments are to be obtained for the most part through success in open competitive examinations. There are, however, a considerable number of appointments open only to candidates already in some branch of the Service; whilst there are many situations filled by examinations held among those who receive a definite nomination, either directly or indirectly, from the head of a Government department or other high State official.

After Nomination

In the latter case, these situations are known as Appointments by Nomination; but even a nomination is in most instances insufficient to ensure a post and, when vacancies occur, an examination has to be held among those nominated.

It goes without saying that with many of these appointments by nomination it is essential that the candidate shall possess some influence he can bring to bear either directly or indirectly on his behalf. In a few instances, however, the nomination qualification is more or less formal, obtainable by almost anyone who supplies some proof of suitability.

There is no need here to give a complete list of the innumerable nomination posts that are to be obtained; for those who wish to secure a situation under one of the Government departments have only to write to the Secretary of that department in order to learn with whom the actual nomination

rests. Moreover, the right and privilege of granting nomination is subject to alteration without notice in some instances. At the same time, the following brief table will give some idea of the type of appointments now under discussion, and it should be mentioned that in the majority of cases special forms of application are provided for the use of those seeking nomination. Such forms are usually obtainable by writing to the Secretary of the particular department in question.

Particulars of Appointment	*By whom Nominated*
ADMIRALTY—Assistant Examiner, Dockyard Schoolmaster, Clerk, etc.	*The First Lord.*
AGRICULTURE, BOARD OF—Inspector, Civil Assistant, Assistant at Kew Gardens, etc.	*The President.*
CUSTOMS AND EXCISE—Preventive Man	*The Treasury.*
FACTORIES—Inspector	*The Home Secretary.*
PRISONS SERVICE—Clerk, Schoolmaster, etc. (in England only)	*The Home Secretary.*
TRINITY HOUSE—Clerk, etc.	*The Master.*
WAR OFFICE—Senior Writer, Civilian Employee, Schoolmaster, etc.	*The Secretary of State for War*
WORKS, OFFICE OF—Assistant Engineer, Assistant Examiner, Sub-Engineer, Clerk of Works, etc.	*The First Commissioner.*

The following are some of the principal appointments by nomination open to men only :—

Assistants at the British Museum, i.e. at the main museum in the West-Central district of London, and also the Natural History Museum at South Kensington. Candidates must receive the nomination of the Lord Chancellor, the Archbishop of Canterbury, or of the Speaker of the House of Commons. The examination covers in some cases a test in scientific subjects.

Clerks in the House of Commons. The Clerk of the House grants the nomination. The examination is arranged for those of public school and university education.

Junior Inspectors of Schools. These appointments occur only under the Board of Education of England, and application for nomination forms should be addressed to the *Secretary, Board of Education Offices, London, S.W.*1. Honours men from the universities are most likely to be successful candidates.

Factory Inspectors are appointed very largely upon their having acquired considerable personal experience in factories and works, and nomination may be sought from the Home Secretary.

Foreign Office Service embraces Clerkships and also Attachéships in the diplomatic service. The nomination of the Foreign Secretary is necessary, and in some circumstances proof is required that the candidate possesses a private income.

Clerks in the House of Lords must pass an examination corresponding to that for Class 1 Clerkships. Candidates must in all cases secure nomination from the Clerk of the Parliaments, before they can present themselves for examination.

Junior Inspectors of Mines and Quarries. The Home Secretary's nomination is required by candidates for these appointments; but as a matter of fact they are chosen by a Selection Committee, which examines and reports upon the individual qualifications of each applicant.

Generally speaking, personal and practical knowledge of work underground in mines is the main qualification; but the actual examination to be faced after nomination deals not only with the technical but also with the very complex legal side of mines and quarries.

Assistant Clerkships in the Royal Navy, which often lead to PAYMASTERSHIPS, are much sought after. Nomination rests with the First Lord of the Admiralty, and a request for a form of application should be made to his *Assistant Private Secretary, Admiralty, Whitehall, S.W.* 1.

Clerks in the Royal Courts of Justice, Land Registry Office and the Supreme Court of Judicature in England must be nominated by the Lord Chancellor, one of the Principal Judges, the Lord Chief Justice, the Master of the Rolls, or the President of the Probate, Divorce and Admiralty Division.

A. C. M.

BOOK-KEEPING.—VIII

Further Notes on Banks and Banking. Tabulated Purchases. Sales and Returns Books.

THE examples of general crossings of cheques given in the last lesson show that payment of a cheque so crossed can be made only through a bank, without, however, specifying any particular Bank. A special crossing indicates that payment must only be made through the particular Bank specified in the crossing.

The words "A/c payee" signify that the amount must be placed by the collecting Banker to the credit of the payee's account.

The words "Not negotiable" are often written on the face of a cheque. The effect of this is not, as might be supposed, to make the cheque not transferable, but it indicates that the person who receives such a cheque cannot have and is not capable of giving a better title to it than the person from whom he received it had. If a person receives an ordinary cheque in good faith and for value, he can maintain his title to it against all the world, even though the cheque has been stolen from its rightful owner.

If, however, a person receives a cheque marked "Not negotiable," he must be careful to see that the person passing on the cheque has a right to it. In case payment is stopped, or for some other reason the Bank declines to pay the amount, the holder's recourse is limited to the person from whom he received the cheque.

Dishonoured Cheques

It sometimes happens that when a cheque is presented to the Banker payment is refused. The cheque is then said to be "dishonoured." When the person who has paid the cheque into his Bank for collection is notified that a cheque has been dishonoured, it becomes necessary for him to debit the person from whom the cheque was received, and to credit the Banker. This may be done by entering the person's name on the credit side of the Cash Book and inserting the amount in the Bank column as if it were a payment made to the person named.

A cheque when returned dishonoured may be marked by the Banker in any of the following ways :—

I/F = Insufficient funds
N/S = Not sufficient
} that is to say, the drawer has not a sufficient amount standing to the credit of his account at the Bank, with which to meet the cheque.

N/A = No assets, signifying that there is nothing standing to the credit of the drawer in the Bank's books.

R/D = Refer to drawer. This is usually a polite way of saying that the account is not in credit, although sometimes it may merely mean that the cheque is not in order, e.g. the words and figures may differ ; there may have been an alteration made which has not been properly initialled or signed.

Bank Reconciliation Statement

As the Bank pass book has the record of a person's transactions with the Bank, and as the Bank columns of his Cash Book show the Bank's transactions with him, the balance of the pass book should agree with that of the Bank columns in the Cash Book. In many cases, however, it will be found that the two do not agree. This may be due to the fact that certain cheques which have been paid away and entered in the Cash Book have not yet been presented to the Bank for payment. It may also happen that payments into the Bank have not yet been credited in the pass book. In order to show the exact position, and thus reconcile the two balances, a statement, called a Bank Reconciliation Statement, is made out somewhat as follows :—

BANK RECONCILIATION STATEMENT

24th March, 19..	£	s.	d.	£	s.	d.
Balance as per pass book ..				290	3	8
Add amounts paid in but not credited :—						
March 23	38	10	–			
„ 24	45	6	4	83	16	4
				374	–	–
Less cheques not presented :—						
G. Mills	78	–	–			
R. Franks	19	12	6	97	12	6
Balance as per Cash Book				£276	7	6

The ever-increasing complexity of modern business renders it imperative that every possible use should be made of time-saving methods. The tabular system provides an excellent means of showing in a clear and concise manner records which otherwise would be complicated and tedious.

The following is an example of a **Tabular Purchases Book**, which shows how the purchases of different classes of goods may be entered so as to give complete particulars at a glance.

TABULAR PURCHASES BOOK

19..		Name	Fol.	Total			Cotton			Wool			Satin		
				£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Aug.	3	John Wakeley		203	16	3	30	10	–	75	3	8	98	2	7
	9	Robert Jevons		421	4	9	106	9	–	153	12	–	161	3	9
	16	Edwin Hollis		361	10	–	163	–	–	96	10	–	102	–	–
	20	James Martland		178	10	1	36	–	–	98	3	2	44	6	11
				£1165	1	1	335	19	–	423	8	10	405	13	3

This method of tabulating the purchases may be extended almost indefinitely, no matter how numerous the details may be. Certain classes of goods can be grouped together and shown in one book, thus obviating the necessity of dissecting the entries made in a single Purchases Book of the ordinary kind.

In the example shown details are omitted, but it would be quite easy to record full particulars if so desired.

The posting to the Ledger from this tabular book is quite simple. It will be necessary to open a separate Purchases Account for each class of goods, that is to say, a Purchases Account (Cotton) will first of all be opened and debited with the £335 19s. 0d., representing the purchases of that commodity. A Purchases Account (Wool) will be debited with £423 8s. 10d., and Purchases Account (Satin) with £405 13s. 3d.

The Personal Accounts will be credited with each separate purchase.

It is possible to use a **Tabular Sales Book** in precisely the same form as shown at the bottom of this page.

Each of the Sales Accounts for the three classes of goods will be credited, and the Personal Accounts will be debited.

The student will at once see that a Purchases and Sales Returns Book can be kept in exactly the same form.

It is possible for a trader who deals in various kinds of goods to be making a profit on one department whilst another section of his business is being run at a loss. It is only possible for him to determine the true facts by keeping the accounts of the various departments distinct. A Stock, Trading Expenditure (such as Wages, etc.), and Trading Account would in that case be kept for each department or for each class of goods. Taking the examples already shown in the Sales Books, the Stock, Wages and Trading Account would then be arranged as on page 182.

Definitions of Terms

Open Cheque: A cheque which has not been crossed.

Post-dated Cheque: A cheque bearing a date which has not yet arrived.

Ante-dated Cheque: A cheque bearing a date prior to that on which it was drawn.

Stale Cheque: One which has not been presented for payment within a reasonable time after being drawn.

Forged Cheque: One upon which the signature has been forged, i.e. placed without authority, with the intent to defraud. The Banker is liable if he pays a cheque where the signature of the drawer has been forged, as he is expected to be familiar with the signatures of his customers. F. H.

TABULAR SALES BOOK

19..		Name	Fol.	Total			Cotton			Wool			Satin		
				£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Aug.	23	Joseph Turton		239	3	6	40	–	–	98	–	–	101	3	6
	24	Evan Roberts		598	14	5	112	3	6	201	6	9	195	4	2
	26	Thomas Williams		390	4	5	169	–	–	101	4	5	120	–	–
	30	Eli Davies		211	15	5	42	–	–	116	16	3	52	19	2
				£1349	17	9	363	3	6	517	7	5	469	6	10

Dr.	STOCK ACCOUNT (COTTON)	*Cr.*

Dr.	STOCK ACCOUNT (WOOL)	*Cr.*

Dr.	STOCK ACCOUNT (SATIN)	*Cr.*

Dr.	WAGES ACCOUNT (COTTON)	*Cr.*

Dr.	WAGES ACCOUNT (WOOL)	*Cr.*

Dr.	WAGES ACCOUNT (SATIN)	*Cr.*

Dr.	TRADING ACCOUNT (COTTON)	*Cr.*

Dr.	TRADING ACCOUNT (WOOL)	*Cr.*

Dr.	TRADING ACCOUNT (SATIN)	*Cr.*

SHORTHAND.—VII

Key to Exercise 28

1. towel, fowl, Filey, July, saucily, vessel, measles, senseless.
2. roam, army, arrow, roast, arrest, arrayed, bar, barrow.
3. sorrows, six, suppose, sweeps, places, rises, physic, desk.
4. *We-shall* conquer *all our* troubles *if* only *we* look *on-the* bright side *of things.*
5. *Our* new polish *is* making head*way, and-the* sales *for-the* past *year* satisfy *us.*
6. *The* partial success *of-the* huge scheme *of-the* sugar refiners *was a* blow *to-the* shippers.
7. *We-shall* push *our* wringers *during-the next year and* hope *to* show increased sales.
8. *Please give us the* details *of-the* sweets *and* tobacco business *which-you have on-your* books *for* sale.
9. *We-have*-just seen Fred Clegg *who* now occupies *a* post *in a* Leicester bank, *and he tells us he-is* making progress *in-his* new sphere.
10. Messrs. Marshall & Driver *are doing-the* extensive changes *in-the* factory *in* Swan Road, Manchester.
11. *We-have* read "Guy Mannering," "Kenilworth" *and* "Woodstock" *in-the* past month, *and* hope *to* enjoy "*The* Toilers *of-the* Sea," *by* Victor Hugo, *as* soon *as we-have*-time.
12. *Our* stock *of* wringers *is* low, *but we-can* offer *you special* value *during our* sale.

Key to Exercise 29

Final Hook N.—A small final hook written on the same side of a straight stroke as hook *r*, adds *n*; thus—

prn, brn, trn, drn, krn, grn.

Vocalising the above forms gives the following words—

prone, brown, train, drain, crown, grown.

The following outlines should be noted—

rain, won, yawn, ken.

Final Hook F or V.—A small final hook written on the same side of a straight stroke as hook *l* adds *f* or *v*; thus—

pluff, bluff, clef, glove.

The following outlines should also be noted—

rough, weave, hove.

A few more examples in which there are initial and final hooks are given—

drive, plain, prone, crave, glean, grove.

Hook N to Curves.—A small final hook inside a curve adds *n*; thus—

fine, vine, thine, assign, zone, shown, main, noun, lane, earn.

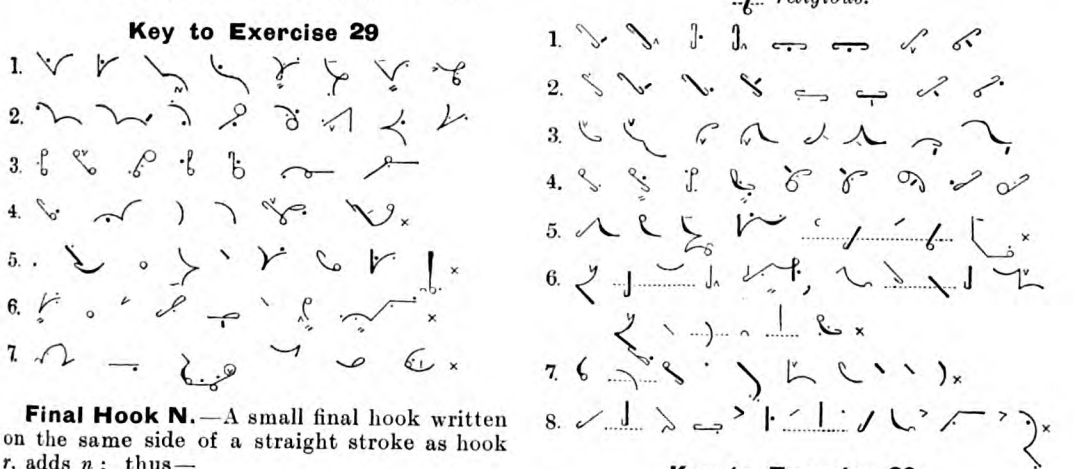
There is no *f* or *v* hook to curves; hence, *f* or *v* following a curve must be represented by the stroke; thus—

fife, thief, muff, enough, love, shove, arrive.

Exercise 30

GRAMMALOGUES

happen, upon; been; had been, done, down; generally, religion; religious.

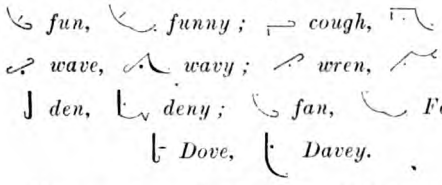


Key to Exercise 30

1. prune, brown, train, drown, crane, grain, wine, hone.
2. plan, proof, brief, blown, clan, glove, wove, heave.
3. fine, fife, line, live, shun, shove, moon, move.
4. spin, Spain, satin, Stephen, swollen, stolen, sworn, starve, swerve.
5. *We-have several* volumes dealing *with religion and religious* topics.

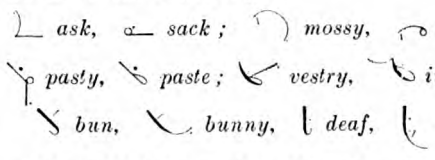
6. *I-shall-be down in* town *on*-Wednesday, *and-if-you happen to be done in*-time *I-shall-be*-pleased *to see you at* seven.
7. *This year has-been a* busy time *for all of us.*
8. *We had-been upon-the* cliff *all-the* day *and had a general* view *of-the* wreck *of-the* airship.

N and F or V and a Final Vowel.—As the hooks *n* and *f* or *v* are final, it follows that when a word ends in a vowel preceded by *n*, *f* or *v*, the stroke must be written; thus—



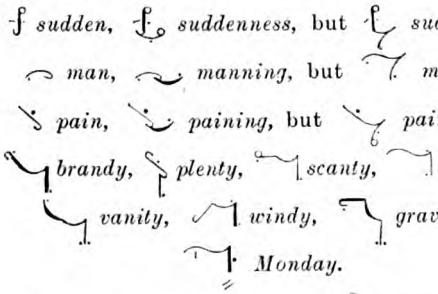
fun, funny; cough, coffee; wave, wavy; wren, renew; den, deny; fan, Fanny; Dove, Davey.

Here we have illustrations of the statement that a final vowel must be preceded by a final stroke; and similarly, that an initial vowel must be followed by an initial stroke. Thus we have the following:—



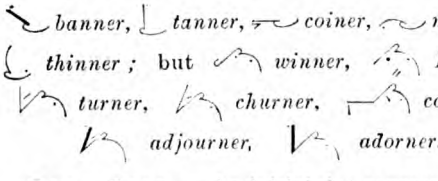
ask, sack; mossy, moss; pasty, paste; vestry, investor; bun, bunny, deaf, defy.

Medial N, F or V.—Medial *n*, *f* or *v* may be represented by the hook if a good joining results; thus—



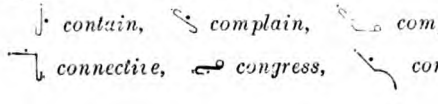
sudden, suddenness, but *suddenly; man, manning,* but *manly; pain, paining,* but *painless; brandy, plenty, scanty, minute, vanity, windy, gravity, Monday.*

Ner.—The final syllable *-ner* is represented by ⌣ when following any stroke except the straight upstrokes, in which case hook *n* and downward *r* are written; thus—



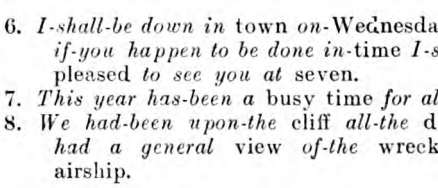
banner, tanner, coiner, manner, thinner; but *winner, Rayner, turner, churner, coroner, adjourner, adorner.*

Con-, Com-.—An initial dot represents the syllables *con-* or *com-*; thus—



contain, complain, complex, connective, congress, compare.

Ing.—A final dot represents *-ing* where the stroke does not join easily; thus—



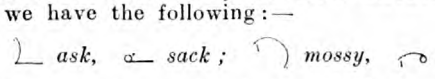
paying, tying, chewing, soaring, staring, lining, shining, craving, weaving.

Ings.—This syllable is represented by a *dash* where the dot *-ing* would be used; thus—

morning, mornings; craving, cravings; turning, turnings; lining, linings; sweeping, sweepings.

Exercise 31

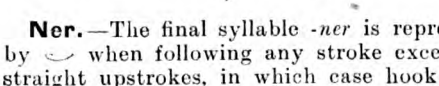
GRAMMALOGUES



often, Phonography; heaven, have been; within; southern, northern.

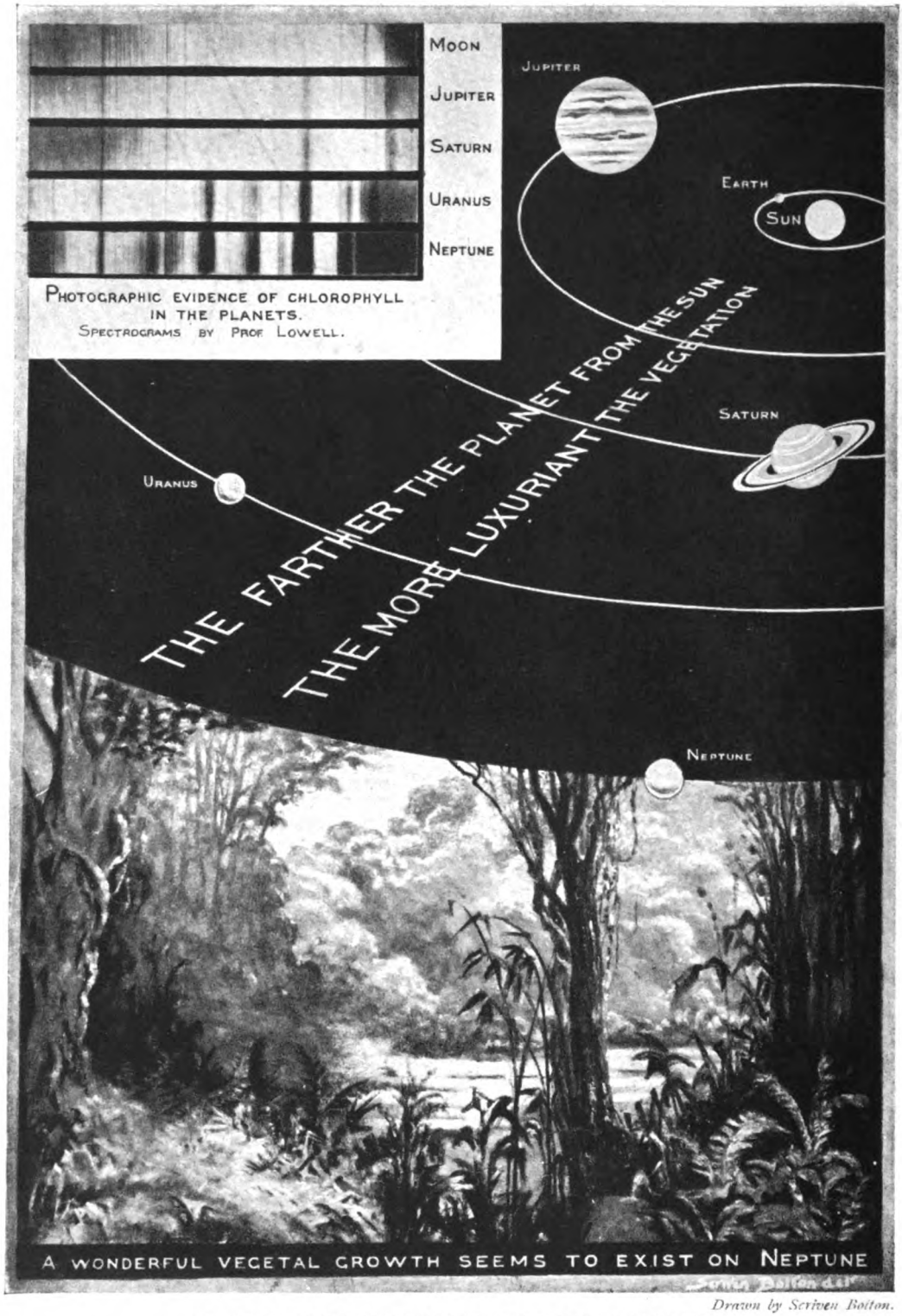
Exercise 32

GRAMMALOGUES



approve; behalf, above; advantage, difficult.

1. Ben, tiny, china, defy, love, lone, Defoe, Dinah.
2. advance, refer, Devon, pinning, gaining, loving.
3. churner, spanner, diner, skinner, gunner, miner.
4. commit, contain, conform, combat, batting, jotting, turning.
5. *We* hope *you approve of-the* samples.
6. *It-is to-your advantage to*-master *a difficult* exercise.
7. *On behalf of-our principal we give you a* month's notice.
8. *We saw-the* cathedral *of*-Lincoln towering *above-the* city.



Drawn by Scriven Bolton.

DOES PLANT LIFE EXIST ON THE PLANETS?

To this—one of the many astronomical questions awaiting solution—Mr. Scriven Bolton suggests an answer in the affirmative, basing his theory on some remarkable spectroscopic photographs (shown above) taken by Prof. Lowell in the clear skies of Arizona. In these spectrograms are certain dark lines which exhaustive experiments would seem to show can be produced only by chlorophyll—the green colouring matter of vegetation.

Continued from page 129.

ENGLISH LANGUAGE AND LITERATURE:

Contributors:—ENGLISH LANGUAGE (W. A. Craigie, M.A., LL.D.; E. W. Edmunds, M.A.). ENGLISH LITERATURE (John Derry, J.P.). PHILOSOPHY (E. H. Tripp, Ph.D.). POLITICAL ECONOMY (J. W. Urwin). ETHICS (W. H. Koebel). PUBLIC SPEAKING (J. W. Urwin).

DRAMA AND POETRY FROM SHAKESPEARE TO MILTON

THE drama, commonly described as Elizabethan because its period of inspiration was wholly in the reign of the Maiden Queen, arose, flourished, and declined within sixty years. The rapid rise, and the glorious culmination in Shakespeare, have been outlined in our last chapters; it remains to mention some of the omitted contemporaries of Shakespeare, and to watch the fading glow of the Elizabethan day.

While the Elizabethan literature is so varied as to include Spenser on the one hand and Milton on the other, with Shakespeare as the central figure, and in prose may be said to link Bacon and Bunyan, it is the drama that forms the clearest central measuring line, and, judged by the drama, the literary curve of the period rose for nearly thirty years, and for nearly thirty years declined.

A Period of Decline

The dates should be noted. Lyly, Greene, Peele, and Nash were busy in London by 1584, and Marlowe's *Tamburlaine* was acted in 1587. This was the beginning. Shakespeare became active about 1594, and probably had ceased to write by 1612. By that time the culmination was past. James Shirley, the last sharer of the Elizabethan spirit of romance, closed his work for the stage in 1641. Thus ended the period of decline; but, during this later stage, came the distinctive, early poetical work of John Milton, who, though standing apart in splendid isolation, was an Elizabethan in spirit and outlook. To him a separate chapter must be allotted.

Tendencies that may be clearly observed running through this period of decline —apart from the writings of Shakespeare and Milton—are, in the drama, a change from presenting the great permanent emotions of humanity to a study of the passing manners of the day; and, in serious poetry, a drift into satire, and the growth of a complex and pedantic style. The lightness and grace of early Elizabethan song were, however, continued, and almost sustained, and there was a steady advance, with some notable exceptions, in the ease and adaptability of prose.

Samuel Daniel, born two years before Shakespeare, and Michael Drayton, born one year before Shakespeare, became notable writers in their day, but have failed to hold their ground. Daniel joined the sonnet-writing movement with ardour, and wrote, as a serious duty, a long rhymed history of the Civil Wars; but his best work was done in prose, though he defended rhyme strongly. His English was clear and modern, and he helped to free the language from classical encumbrances.

Michael Drayton occupies an interesting position, inasmuch as he lived through the whole of the formative period of Elizabethan literature, and, in succession, adopted or imitated every literary fashion. He was born near Atherstone, in Warwickshire, and never allowed his readers to forget it. From boyhood he strove diligently to be a poet, with the curious result that his writing improved till he was nearer seventy than sixty.

Michael Drayton

Paraphrases of Scripture, songs, sonnets, historical legends, rhymed history, plays, imaginary letters by the dead, satires, odes, poetical geography, and fairy fancies were tried by him in succession, with irregular skill. Drayton's great work, and the disappointment of his life, was his *Polyolbion*, a description of England from a poet's point of view. It was historically annotated by

John Selden. The aim was too ambitious, and the poem was bound to sink into sameness; but it retains considerable interest for home-loving travellers.

Following now the course of the drama, which Daniel and Drayton did not affect, we see Ben Jonson as the most conspicuous and influential contemporary of Shakespeare, and with him are George Chapman, Thomas Dekker, Thomas Middleton, and John Marston, Francis Beaumont and John Fletcher, the latter being Shakespeare's most intimate follower and fellow-worker when the great poet was withdrawing gradually from his stage associations; John Webster and Philip Massinger, who were nearly twenty years younger than Shakespeare; and John Heywood, John Ford, and James Shirley, who carried on the Elizabethan tradition to a later day.

Controversy will always be kept up as to the nature of the literary influence wielded by Ben Jonson. Ben was a scholar and classicist, zealous for the methods of ancient learning and stagecraft, and his work narrowed the scope of the English drama. Whereas Shakespeare had made the drama represent every phase of life and character, in such mixed conjunction as they have in real life, and had probed the profoundest problems of the human mind—problems that appeal to mankind in every age—Jonson turned the attention of the stage to contemporary manners and fashions, and sought to bring dramatic construction within the rules which ancient criticism had set up.

Ben Jonson and—

It must be admitted that while Shakespeare's transcendent genius and instinctive taste had defied successfully the rules known as "the unities"—that is to say, one plot for each play, giving unity of action; unity of time within twenty-four hours; unity of place, the space being such as could be covered in the time—and had swept his plays along with such breathless interest that quibbling restrictions were forgotten, the construction of romantic plays under his less gifted followers became loose, and a movement towards compactness was desirable. From that point of view Jonson's influence was good.

Nor can it be denied that one of the functions of the theatre may, with advantage, be the satirising of the special weaknesses of each successive age. Every generation needs to be laughed, or perhaps scorned, out of its follies. But in that direction lie mere display, crazes for the follies exposed, and the triviality which robs the drama of its power over deep emotion. Instead of the profundity which moves to tears, to laughter, to pity, to terror, and to perplexed surmise, we at last get—pantomime, or the inanities of the "revue." Ben Jonson represents, though far off in the beginning, the theatre of people who want to see, and do not want to think—the theatre of the moment and not of the mind.

Personally, Jonson was a strange compound of genuine learning and egotistical swagger; of fierce jealousy and outspoken generosity; of bullying quarrelsomeness and forgiveness, merging into boon companionship. He was born poor, worked with his hands—perhaps as a bricklayer—went to Westminster School, possibly to Cambridge, then to the wars, and showed strong traces of each phase of his haphazard training. He was a mass of contradictions, which included a fine vein of poetry and a bear-like grossness. There was scarcely one of his contemporaries whom he did not abuse, if not traduce, and there were few that he did not loyally praise. The art of the man and the man himself resembled fine embroidery on a coarse ground.

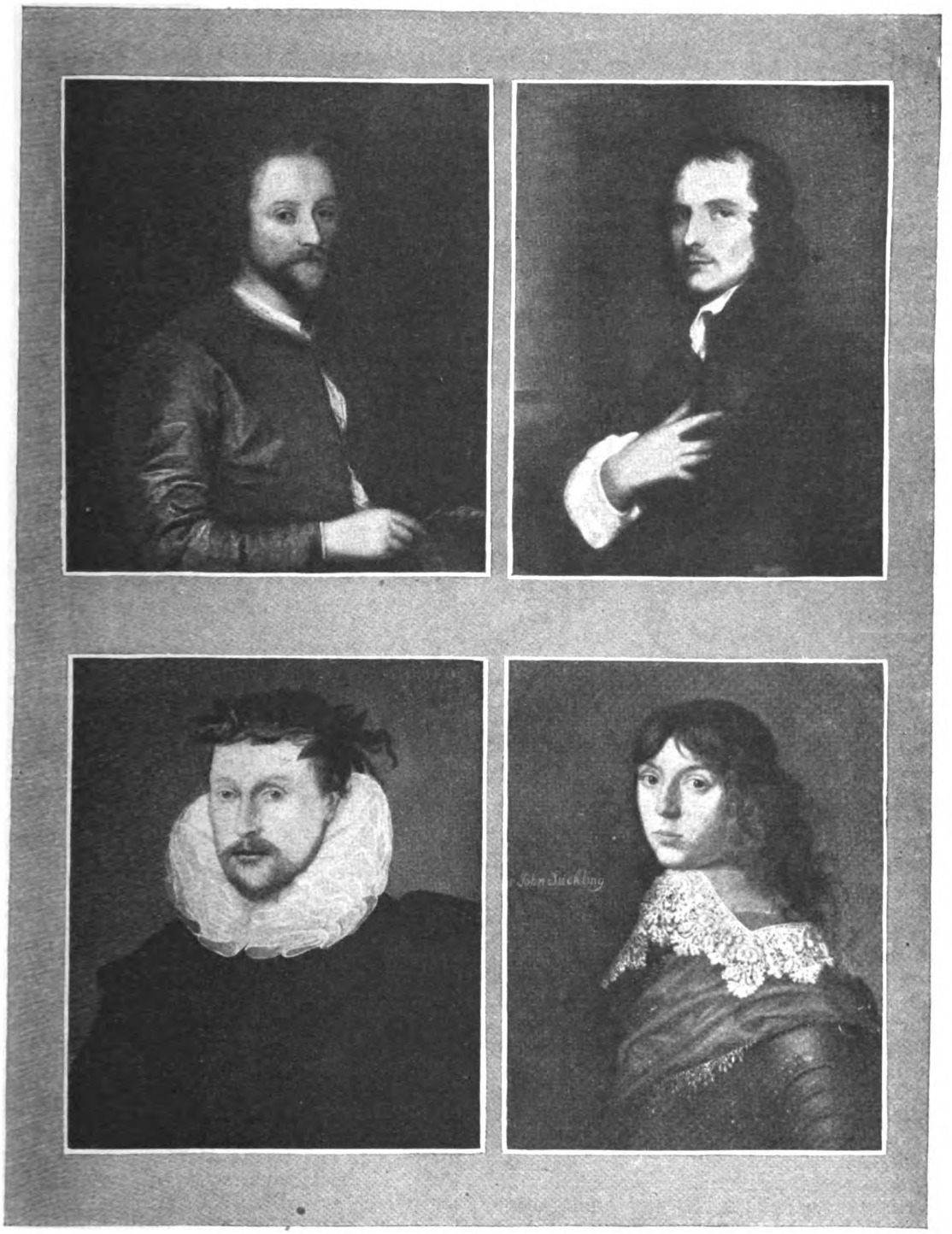
—His Plays

Jonson was both an actor and a playwright when he was four-and-twenty, and the next year (1598) made himself famous by his *Every Man in His Humour*, which was produced by Shakespeare's company. His avowed object was to present

> An image of the times,
> And sport with human follies, not with crimes.

The play was much more successful than several similar satirical comedies that followed. In 1603 Jonson attempted tragedy in a learned, classical play, *Sejanus*, and eight years later returned to the same vein in *Cataline;* but his tragedy was too stilted for the stage of that or any later period. In the time between these two tragedies—from 1605 to 1610—when Shakespeare was in the height of his fame—Jonson lashed the vices and follies of the period in the compactly-constructed comedies, *Volpone*, *The Silent Woman*, and *The Alchemist*, and the more rambling but realistic *Bartholomew Fair*. Both *Volpone* and *The Alchemist* satirise greed. *The Silent Woman* was more farcical in style. At the same time Jonson became the most notable writer of masques, a form of entertainment that long remained popular in the circles of the Court and great houses.

During this period of high favour and



FOUR PRE-RESTORATION POETS AND DRAMATISTS.

1. **John Fletcher** (1579—1625), a notable dramatist, whose best work was done in collaboration with **Francis Beaumont.** (*Photo: Emery Walker, from a portrait by a painter unknown.*)
2. **Andrew Marvell** (1621—1678), poet and satirist. (*From the portrait by Adrian Hannemann.*)
3. **Michael Drayton** (1563—1631), poet and dramatist. (*From a portrait by a painter unknown.*)
4. **Sir John Suckling** (1609—1642), one of the most graceful lyricists of the period. (*From the picture in the Ashmolean Museum, Oxford.*)

popular success occurred the merry meetings at the Mermaid, when Shakespeare and Jonson shone in social rivalry, while writers like Drayton, Beaumont and Fletcher looked on and admired.

In his later years Jonson, though remaining the chief literary figure after the death of Shakespeare, fell out of popular favour, forswore the stage, but later returned to it with indifferent success as playwright. Towards the end he received, as laureate, a comfortable pension, but was harassed by ill-health. He died in 1637, and, in the Poets' Corner of Westminster Abbey, has the most happily laconic of epitaphs—"O, rare Ben Jonson!"

Most of the later Elizabethan dramatists who must be briefly mentioned here were contemporary with Shakespeare, though younger men. Thomas Dekker, John Fletcher, John Webster, and Philip Massinger collaborated with him, and Fletcher and Massinger carried on the Shakespearean tradition. George Chapman, John Marston, and Thomas Middleton were imitators of Ben Jonson's classical dramatic methods. Of the lives of some of these playwrights we know little, and only a small selection of their works has been preserved. Several will live by their lyrics. George Chapman is the only one who won lasting fame apart from lyrics or the drama.

FRANCIS BACON (1561-1626).
One of the few outstanding figures in English Literature in the period between Shakespeare and Milton.

Chapman, an older man than Shakespeare, was a scholar and a poet. Probably he had a University education, followed by experience abroad, and did not begin to write for the stage till he was nearing his fortieth year. Then he successfully completed Marlowe's *Hero and Leander* (1598). Afterwards he joined Marston and Jonson in satirical comedy, and all three were imprisoned, in 1605, for disrespectful descriptions, in *Eastward Ho!* of the Scottish followers of James I. He also wrote a popular comedy, *All Fools!* Later, he went to French history for the materials for the rhetorical romances *Bussy D'Ambois*, *The Revenge of Bussy D'Ambois*, and the *Tragedy of Charles, Duke of Byron*. In these plays he returned to the earlier Elizabethan style of bold sentiment with a melodramatic tone. It is, however, to his fine, flowing translations of Homer that Chapman chiefly owes his fame.

John Marston, who was imprisoned with George Chapman for slighting the Scots, in *Eastward Ho!* and was joined voluntarily in durance by Ben Jonson because he also had helped to write the comedy, was a strong, satirical writer, fond of exchanging literary fisticuffs. He often quarrelled with his confrère Jonson, who once beat him with his own pistol. Marston's most notable play was *The Malcontent*. After a roystering early life, regretted later, Marston became a clergyman and vicar of the ancient Christchurch Priory. Shortly before his death, in 1634, he returned to London, and is buried in the Temple Church.

Thomas Dekker, one of the most prolific writers of the Shakespearean age, outlived Shakespeare by a quarter of a century. The bulk of his writing is lost, and unfortunately we know but little of the man; but what is known, or can be inferred, suggests a kindly, careless, lovable fellow, with a strain of fine poetry in him. His best known play is *The Shoemaker's Holiday*.

Thomas Dekker's prose writings are also of much interest to the close student of literature and the student of social usages, for he was one of the earliest writers of a clear, unaffected prose style, and in his pamphlets, as well as his comedies, gives a welcome picture of the average life of citizens of his day, with a kind thought for the poor. "God help the Poor, the rich can shift," was one of his mottoes.

The best-balanced of the dramatists of the time were Beaumont and Fletcher. Francis Beaumont, the son of a judge, was twenty years younger than Shakespeare; and John Fletcher, the son of a bishop, was

fifteen years younger than Shakespeare. Beaumont died in the year of Shakespeare's death, and Fletcher lived nine years longer. So both may be said to have died comparatively young. Much ingenuity has been expended in separating, on literary grounds, the work of Beaumont from the work of Fletcher in the many plays attributed to them jointly; but Fletcher worked with drama, but his liberties with rhythm tended to weaken the power of an unrhymed style. It is unfortunate, too, that Beaumont and Fletcher wrote down to the morals of their age in such a degree as to make many of their plays very dubious reading, judged by modern taste.

Thomas Middleton (1570–1627) was a confirmed collaborateur. He wrote with Dekker,

From the picture by William Dyce, R.A., in the Guildhall, London.

GEORGE HERBERT (1593–1633) AT BEMERTON.

One of the most graceful and tantalizing of the Stuart poets. On the death of James I. he eschewed "the painted pleasures of the Court" and retired to Bemerton Rectory.

other comrade writers besides young Beaumont — with Shakespeare, Jonson, and specially with Philip Massinger. Beaumont's best-known plays produced on his own account were *The Woman Hater* and *The Knight of the Burning Pestle*. Among plays written together by the two friends, the best are *The Maid's Tragedy*, *Philaster*, *A King and No King*; while Fletcher wrote alone *The Faithful Shepherdess*; *The Two Noble Kinsmen*, probably with Shakespeare; and parts of *Henry VIII.* with Shakespeare, and possibly also with Massinger. Beaumont had the more constructive mind and restraining judgment; Fletcher, the finer lyrical genius. Fletcher brought such freedom into blank verse as to dispense with any need for prose in the Drayton, Webster, Rowley the actor, and probably Jonson and Fletcher. His style was smooth, and he had considerable dramatic power, but without poetical inspiration. The tragedy *The Changeling* is his best-known play.

Philip Massinger, who was about twenty years junior to Shakespeare, was a disciple of John Fletcher, with whom he wrote constantly, and through Fletcher belonged to the school of Shakespeare. He also touched Shakespeare by collaborating with the Shakespearean poet Thomas Dekker. In a high degree Massinger had the power of dramatic construction, with a style that rose easily into fine oratory, but never into fine poetry. His comedy *A New Way to Pay Old Debts* held a place on the stage almost

till modern times, owing partly to the attraction for star actors of the miserly character Sir Giles Overreach.

John Webster, a powerful writer who worked jointly with Dekker, Drayton, Marston, Middleton, and Heywood, brought back into the drama the blood-stained style of Kyd, rivalling that playwright's gruesome *Spanish Tragedy* in his *White Devil* and *Duchess of Malfi*. In imaginative power Webster and John Ford rank highest among the dramatists who followed Shakespeare. Of neither is much known, except what may be inferred from their writings. Ford's fine tragedy *The Broken Heart* is loftily conceived, but is worked out with a subservience to purely romantic ideas that amounts to moral obtuseness. His *Perkin Warbeck* was the most natural and convincing historical play since Shakespeare's *Henry V.*

The actor-author Thomas Heywood, whom Charles Lamb described as "a sort of prose Shakespeare," was the most prolific playwright of the first half of the seventeenth century. He boasted that he had had "a main finger" in the writing of 220 plays. Of these, *A Woman Killed by Kindness* is best known.

Shirley and Donne

By universal assent, James Shirley, who was born in 1596 and died in 1666, is regarded as the last dramatic writer who adhered to Elizabethan traditions. A Londoner by birth, he was educated at the Merchant Taylors' School, at Oxford and at Cambridge. He varied play-writing with schoolmastering. Before the downfall of Charles I. he was attached to the Royal Court, and as a masque writer was a disciple of Ben Jonson. His career as a playwright was cut short by the Puritan closing of the theatres.

He and his wife died on the same day, through grief, loss, and excitement caused by the Great Fire of London. In him the Elizabethan drama expired, not unworthily.

Apart from the drama special mention must be made of one poet of strong individuality and considerable influence. John Donne was about ten years junior to Shakespeare, and outlived him fifteen years. Though poetry was, according to his own account, the mistress of his youth, while divinity was the wife of his age, and in his youth he was at Court in London during the full plenitude of Shakespeare's genius and popularity, he seemed to live a detached literary life outside the general current of the age. Yet his sonnets, and other poetical writings, became very well known, and soon exerted a wide influence, as perverse as it was pervasive.

Brought up as a Roman Catholic, Donne wrote love and other poetry characterised by great intensity, and a kind of warped intellectuality. He brought afresh into poetry the "conceits" which so rudely jar the modern reader in much 17th century verse. Turning Anglican, Donne was ordained, became Dean of St. Paul's, and the most popular preacher of his generation. His classical style, disfigured by intellectual ingenuities, was hailed as "great" by the young poets of his day.

The bright lyrical strain of the early Elizabethans, as illustrated in Shakespeare himself, and such contemporary song-writers as Thomas Campion, was continued through John Fletcher, Thomas Carew, George Wither, Robert Herrick, Sir John Suckling, Sir Richard Lovelace, and Andrew Marvell to John Milton.

George Herbert

This tendency may be seen in fanciful love poetry and the religious verse, which began now to be a feature of our literature. A line of descent can be traced in imaginative religious outpourings from Spenser, through Giles Fletcher and George Wither to Marvell and Milton.

The most tantalising of the poets who mar graceful thought and melody by a sudden mixture with crude metaphors is George Herbert, who found a staunch patron in King James I. On James's death he renounced "the painted pleasures of the Court" and retired to the Rectory of Bemerton, where he died—a victim of consumption—at an early age. Here is an example of his verse:—

Sweet day, so cool, so calm, so bright!
The bridal of the earth and sky!
The dew shall weep thy fall to-night,
For thou must die.
Sweet rose, whose hue, angry and brave,
Bids the rash gazer wipe his eye,
Thy root is ever in its grave,
And thou must die.

Very musical are the twitterings of the small birds of song in the first half of the 17th century after the mighty harmonies of Shakespeare had died away, but all the while, withdrawn apart, was one who was preparing to sing, in a new music of language, "things unattempted yet in prose or rhyme." All the poets after Shakespeare only served to pass the time till Milton came.

J. D.

Continued from page 134.

HISTORY:

Contributors:—J. A. Brendon, B.A.(Oxon.), F.R.Hist.S.; F. Collinson, F.R.Hist.S.; T. P. Evans, B.A.(Oxon.); James A. Manson; L. Stampa, M.A.(Oxon.); and J. B. Sterndale-Bennett.

THE CRUSADES.—II

OF all the occurrences in mediæval history few were more romantic, more fascinating, or indeed so profound and far-reaching in their consequences as was the Crusading movement. There is, however, a tendency to exaggerate its political significance. Politically, the Crusades accomplished very little. Their social, economic, and intellectual effects, on the other hand, were incalculable. In the first place, they brought into the field of active contest the two great religions of the modern world, ranging the chivalry of Christendom against the chivalry of Islam, and so making East and West better acquainted with each other.

What the Crusades Accomplished

Moreover, although Jerusalem was not permanently delivered, nor the Holy Sepulchre —save for a brief space—rescued from the custody of Moslems, a check was imposed on the energy of Mussulman conquest, which had important indirect effects. As a result of contact with the jewelled and sumptuous East, Europe during the later Middle Ages became coloured by many gorgeous reflections. The feudal nobility acquired a new grace and character. Romance and poetry received fresh life and larger sympathies; education received an enormous stimulus.

The Crusaders, it must be remembered, were introduced to cities and localities associated with the highest intellect and culture of the ancient civilisation; and the intensity of their struggle with the Moslems acted as an inspiration which centuries failed to exhaust.

Again, the religious wars of the twelfth and thirteenth centuries led to an enormous increase in commercial intercourse between Europe and Asia, and to the gradual formation of more tolerant views in religious matters. The Mahommedans, who formerly had been looked on as infidels and incarnate devils, were found, after all, to be human beings who professed a religion that had much in common with Christianity.

Europe and Asia, in fact, came gradually to understand each other, and the result was mutually beneficial. This was not so in the case of the wars that had been waged in the past between the Saracens and the nations of Eastern Europe. These were struggles for life or death. The battles of the Crusades, on the other hand, were fought for the sake of a principle; and acquaintance with another form of religion considerably widened the Christian outlook, producing in Europe a liberality of thought which served as a powerful counterpoise to the increasing pretensions of the Roman Church.

Prominent among the leaders of the First Crusade were Godfrey de Bouillon and his brother Baldwin; Count Raymond of Toulouse; Robert, Duke of Normandy, a son of William the Conqueror; Prince Bohemond of Tarentum and his cousin, Tancred; Count Robert of Flanders; and the Bishop of Puy, who acted as the Papal Legate.

Politics and Strategy

None of the great sovereigns, it will be noticed, joined the expedition; but, despite this, an enormous host of men set out from Western Europe for the Holy Land—according to the lowest estimates it numbered 300,000 men. France and Normandy produced the majority of those enthusiasts; but England, Germany, Flanders, Italy, and other countries also supplied valuable contingents. Unfortunately, however, the army was entirely lacking in the elements of cohesion. The feudal nobles, who led its various units, having each equipped his men at his own expense, declined to accept orders from anyone except when to do so suited them.

The Crusade, it will be remembered, had been instigated by the Eastern Emperor, who appealed to the Christians of Western Europe for assistance against the Turks (*see p.* 134). It was agreed, therefore, that

From the picture by Sir John Gilbert, R.A.

EN ROUTE FOR THE HOLY LAND.

In the First Crusade (1095-1099) none of the great sovereigns took part. None the less, an enormous host, numbering some 300,000 men, set out from Western Europe under the command of Godfrey de Bouillon, who entered Jerusalem on July 15, 1099, when he gave the city over to one of the most hideous massacres recorded in history

Constantinople should be the place of meeting of the Crusading armies. But, for the main purpose of the expedition, it would have been better had they approached Judæa by the direct route of the Mediterranean—the more so, seeing that the immense influx of western troops into his dominions, so far from pleasing, greatly alarmed the Emperor; whilst the demand he made that his visitors should swear fealty to himself naturally incensed the warriors of Western Christendom.

The fact is that East and West had nothing in common. The Emperor merely wanted to see the Turks driven from Asia Minor. But this was an object which had very little interest for the leaders of the First Crusade.

In order to prevent the outbreak of active hostilities between his own troops and those of his nominal allies, the Emperor determined to make an immediate attack on Nicæa.

Jerusalem Captured

The siege of the city was begun on May 8, 1097; but, although assaults were pressed with great determination, the city held out stubbornly until an envoy, sent by Alexius, persuaded the Turks that they had more to hope from the clemency of the Emperor, if they surrendered, than from the mercy of the invaders, should the latter force their way into the town. Accordingly the Greeks and Turks came to an arrangement between themselves; and on June 24 the Imperial troops were able to enter the town secretly and close the gates against their western allies. This act of deceit was typical of the relations existing between the Christians of Western and Eastern Europe.

On July 3 the disappointed Crusaders departed from Nicæa and set out towards Jerusalem. During the course of this dreary march Godfrey de Bouillon's brother, Baldwin, at the head of a small force, detached himself from the main body, and after a hard struggle with the Turks succeeded in reducing the country of Edessa, where, in violation of the treaty which had been made between the leaders of the Crusade, he established himself as an independent ruler.

Meanwhile the main army had arrived before Antioch. The siege of that city continued until June 3, 1098, when at last the place surrendered. A fierce struggle then ensued between several of the Christian captains as to who should be possessed of the prize. After some shameless treachery and intriguing it fell eventually to Bohemond; and in the early summer of 1099 the remnant of the great army began the next stage of its journey; but to such an extent had the Crusading host been depleted by death in battle, desertion, and disease that its effective force was now reduced to about 35,000 men. It was, moreover, sadly wanting in battering rams, towers, and other siege material, and the investment of Jerusalem would have been almost impossible but for the timely arrival at Jaffa of some galleys from Genoa furnished with the very engines that were wanted.

On July 15, 1099, after a siege of two months, the Holy City fell into the hands of the Christians, who unfortunately marred their victory by a massacre as horrible as any recorded in history.

On July 23 the military leaders, in the hope of restoring some semblance of order and discipline to their followers, offered to Godfrey de Bouillon the title, King of Jerusalem. Godfrey declined the honour, protesting that he could not wear a diadem of gold in a city where his Saviour had worn a crown of thorns. None the less, he accepted the office without the title, calling himself Defender and Baron of the Holy Sepulchre. His reign, however, was very short, for he died on July 18, 1100, less than a year after his assumption of office.

Templars and Hospitallers

He was succeeded by his brother Baldwin, and by the middle of the twelfth century the "kingdom" of Jerusalem included a very considerable tract of country.

The Christian state created by Godfrey de Bouillon was for some time administered with conspicuous success; and, although hemmed in by Mahommedan armies, eager to recover the possessions they had lost, it preserved for several years its independence and influence. To this period belongs the establishment of those two very interesting religious orders—the Hospitallers and the Templars. The Order of the Hospitallers was instituted by Baldwin I. The Templars were of somewhat later origin, and derived their name from the fact that they were originally given quarters on the site of Solomon's Temple. Other bodies of a similar character, combining military with religious duties, were founded in subsequent years, and for a long time exercised a powerful influence on the affairs of Europe and of Western Asia. These knights led a life that was at once soldierly and monastic. Their dress was distinguished by a cross, and one of their chief duties was the defence of Palestine.

But, as a result of numerous donations and endowments, these institutions grew to

be fabulously wealthy; and as their pride increased with their riches, they lost much of their religious character. In fact, in course of time the Templars became a menace to the Church, and early in the fourteenth century, at the instigation of the Pope, the Order was brought to a violent end. The Hospitallers, however, continued to exist; indeed still exist, though their headquarters have been transferred from Syria to Malta.

From the painting by James Archer, R.S.A.

ST. BERNARD PREACHING THE SECOND CRUSADE (1144),

which, despite the earnest recruiting zeal of its promotor, served only to weaken the prestige of Christianity in the East.

* * * * *

In 1144, fifty years after the preaching of the First Crusade, the Moslems stormed and took the city of Edessa. The sudden fall of the principality, founded by Baldwin, brother of Godfrey de Bouillon, filled Christians of Asia with alarm. Their feelings, however, were eloquently voiced in Europe by St. Bernard, who renewed the passionate appeals of Peter the Hermit, and demanded a second Crusade to preserve the conquests of the first. The King of France readily agreed to the proposal. The Emperor, Conrad III., also came forward. But the expedition, although inaugurated under such distinguished auspices, proved a miserable failure. Ill-managed from the outset, it accomplished absolutely nothing, and served only still further to weaken the prestige of the Christians in the East.

In 1187 the Moslems attacked Jerusalem, the city at length falling a prize to the military genius of the great Saladin. This led to the Third Crusade—the most famous, perhaps, of all the expeditions to the Holy Land. Richard I. (Cœur-de-Lion), King of England; his political rival, Philip Augustus, King of France; and the aged Emperor, Frederick Barbarossa, all took part in it; and the military operations on both sides were conducted in an eminently soldierly and chivalrous manner. The fact is that the Mahom-

medans and Christians were coming to understand and to respect each other. Commercial relationships and the interchange of thoughts and ideas had broadened the sympathies of both parties, and in 1192, after some brilliant campaigning, Saladin and Richard concluded an honourable peace by which the former, although he retained possession of Jerusalem, agreed to allow Christians to visit the holy places without let or hindrance, and without the payment of any taxes.

This peace may be held to mark the end of the Crusading movement, for although several subsequent expeditions were made to Palestine, the Christians of Western Europe from that time directed their martial ardour more towards Egypt than the Holy Land, and before the end of the thirteenth century all hope of recovering Jerusalem had been abandoned.

* * * * *

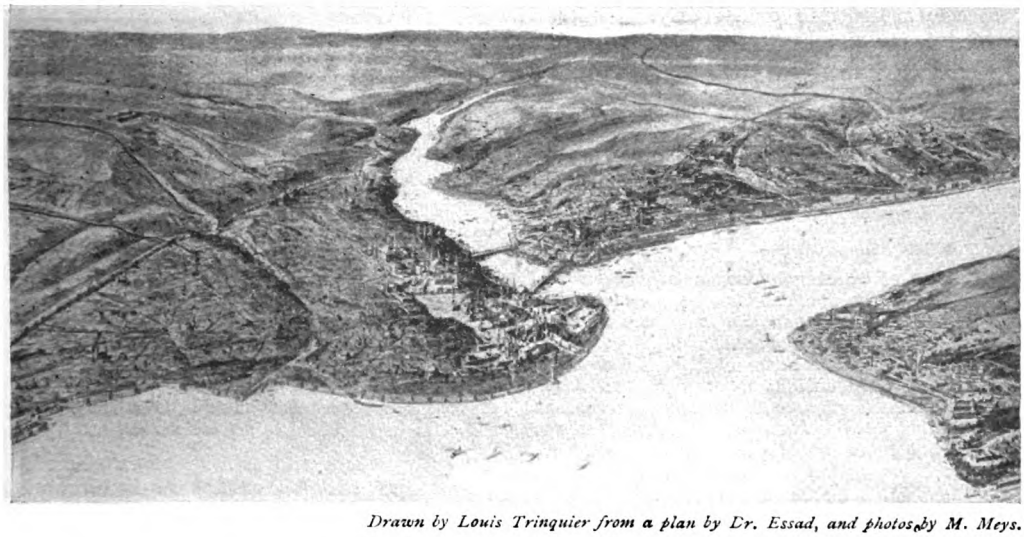
The Saracen, or Moorish, kingdom in Spain continued for a long time, despite the strenuous efforts made for its destruction by the Christian princes of the north. In fact, it was not until 1492, when, as a result of the marriage of Ferdinand of Aragon with Isabella of Castile, the Christian power in Spain had become united under one Government, that the Moslem throne at Cordova was overthrown and broken beyond all hope of restoration.

This was a happy triumph for Christian arms, and served in some measure to counteract the effects of the great blow which the Mahommedans had dealt to Christendom less than half a century before, when in 1453 the Turks, under Mahomet II., captured Constantinople and made every echo in Europe resound to the crash of the old Eastern Empire.

This disaster was not without good results. The Turkish conquest led to the flight of Greek scholars into the countries of western Europe. They took away with them treasured manuscripts of Greek and Latin antiquity, revealing a new world of thought to a naïve and ignorant age. It marked the beginning of the era of enlightenment.

Since 1453 the Turks have steadily maintained their stronghold on the outskirts of Europe, where they have been a constant menace to the civilisation of the West. Twice they have laid siege to Vienna, and although nearly two and a half centuries have elapsed since the last occasion, and although all subsequent threats of aggression have been vigorously suppressed, the problem of the Near East—created by the presence of the Turks in Europe—still awaits solution.

J. A. B.



Drawn by Louis Tinquier from a plan by Dr. Essad, and photos by M. Meys.

CONSTANTINOPLE

which "as long as Europe and Asia, as long as land and sea keep their places must"—to quote Freeman—"remain the seat of Imperial rule." The city, whose eastern part is on the site of Byzantium, was founded by Constantine the Great in A.D. 330; in A.D. 395 it became the capital of the Eastern Empire, and fell into the hands of the Turks in 1453. Facing the reader in the centre of the picture is Stamboul, connected with Pera by two bridges over the Golden Horn. On the right of the picture, on the other side of the Bosphorus, stands Skutari.

Continued from page 149.

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Contributors:—ANTHROPOLOGY AND ETHNOLOGY (Sir H. H. Johnston, G.C.M.G., K.C.B.). ASTRONOMY (Arthur R. Hinks, M.A., F.R.S.). BOTANY (E. W. Edmunds, M.A., B.Sc.[Lond.]). CHEMISTRY (E. H. Tripp, Ph.D.). ELECTRICITY AND MAGNETISM (L. M. Parsons, M.Sc., D.I.C., F.G.S.). GEOLOGY AND MINERALOGY (Arthur Holmes, D.Sc. [Lond.], A.R.C.S., D.I.C., F.G.S.). PHYSIOLOGY (Sir Malcolm Morris, K.C.V.O., and D. W. Carmalt-Jones, M.A., M.D.[Oxon.]). SOUND, LIGHT, AND HEAT (E. W. Edmunds, M.A., B.Sc. [Lond.]). ZOOLOGY (E. A. Bryant and Ashley G. Brown, F.Z.S.).

CHEMISTRY.—XII

Experiment XLIV. —*To prepare chlorine gas.* CHLORINE gas is most conveniently prepared by heating hydrochloric acid with manganese in the apparatus described for Experiment XXXIX. The gas is evolved more regularly if the flask be placed on a water-bath, and as it will contain a little hydrogen chloride it may be passed through water before it is collected by downward displacement.

Chlorine is a yellowish-green gas with an unmistakable disagreeable odour. As it is poisonous, all experiments with it should be performed in a draught of air. The gas is about 2½ times heavier than air, and it dissolves in water to a moderate extent only. Under a pressure of four atmospheres at 0° C. it is converted into a yellowish liquid which comes into commerce in steel cylinders. Chlorine was the poison first used by the Germans when at Ypres in 1915 they introduced the use of gas in modern warfare.

We have learnt that hydrogen chloride is a compound of hydrogen and chlorine. We should therefore expect these gases to combine readily.

Experiment will show:—

(*a*) If a jet of burning hydrogen is lowered into a jar of chlorine, the flame at once becomes luminous and of a mauve colour, at the same time clouds of hydrochloric acid are produced.

(*b*) If a jar of chlorine is mixed with a jar of hydrogen, and then a light is applied, there is a loud explosion and hydrogen chloride is again formed. Direct sunlight also induces the combination and explosion, but there is no action in the dark. We thus learn that: hydrogen + chlorine = hydrogen chloride.

The combination of these gases is attended with so much vigour that we might expect that chlorine would take away hydrogen from substances containing it.

(1) When warm turpentine (a compound of carbon and hydrogen) is poured on to a dry and warm filter-paper, which is then immediately plunged into a jar well filled with the gas, a red flame appears, together with clouds of very dirty smoke, which consist of hydrogen chloride and soot (carbon). Turpentine + chlorine = hydrogen chloride + carbon. These experiments are instructive, as instances of combustion without oxygen.

(2) A taper will burn in chlorine with a dark red flame and emit dirty fumes of hydrogen chloride and soot. The explanation is very similar to that given in (1).

(3) As the two experiments above seem to suggest that chlorine and carbon do not combine directly,

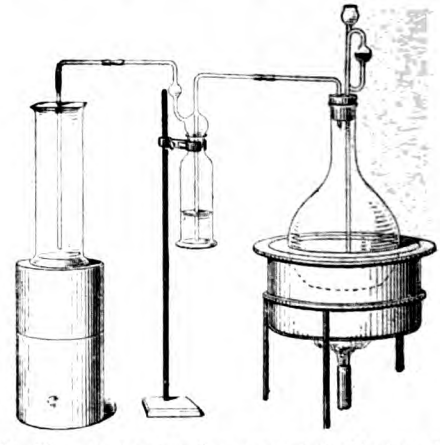


Fig. 19.—Apparatus for preparing chlorine gas.

some charcoal or soot should be heated and put into the gas. There is no action.

In our experiments with hydrogen chloride and metals and metallic oxides we found that the chlorine always combined with the metal. Hence we shall anticipate some firework displays when metals and chlorine come in contact.

(1) When thin copper leaf, called Dutch metal, is dropped into chlorine, it burns with a reddish flame, and dense yellow-brown fumes arise. If a little water be added to the brown deposit which collects at the bottom of the jar, a green-coloured liquid is obtained. Copper chloride is brown when

anhydrous, green when hydrated. Copper + chlorine = copper chloride.

(5) If a small piece of sodium is melted in a deflagrating spoon and then plunged into the gas, a very vivid combustion ensues, and the great heat evolved may melt the brass of the spoon. The white crystalline solid produced is sodium chloride, or *common salt*; it is identical with the product of the action of salt-gas upon sodium (Experiment XL). Sodium + chlorine = sodium chloride.

(6) If some powdered antimony* be shaken into a jar of chlorine, it ignites, throws out bright sparks and produces white fumes of antimony chloride. Antimony + chlorine = antimony chloride.

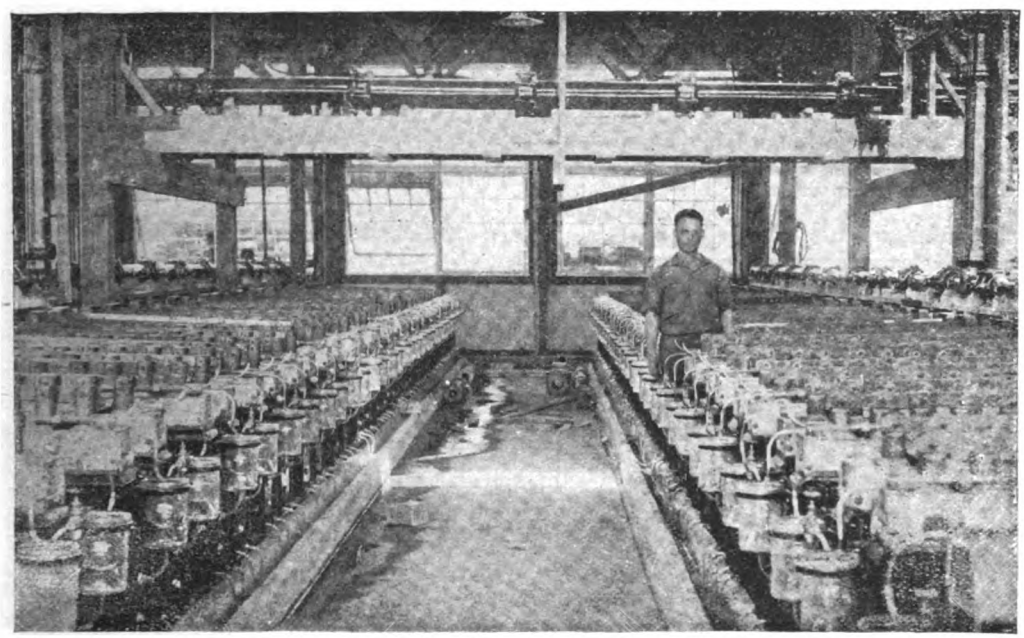
(7) If some phosphorus be lowered into a jar, it will be observed to melt, and then to throw off sparks and emit white fumes which consist of a mixture of two chlorides of phosphorus.

be bleached, but the print will be unaffected, as it consists of lampblack, a form of carbon.

Chlorine is also a powerful disinfecting agent, and is much used in sanitary work.

On account of these two valuable properties, the question of its storage and transport is an important one. Water is an unsuitable medium, because it dissolves but little (about $2\frac{1}{2}$ volumes in 1), and the solution called "chlorine water" cannot be preserved except in the dark.

A round-bottomed flask is completely filled with fresh chlorine water, and in the neck is placed a cork, through which passes a narrow glass tube drawn out to a jet. The whole is inverted in a wide-mouthed bottle full of water, and is then exposed to the sun. In course of time a large bubble of oxygen collects



QUID PRO QUO.

Preparing chlorine in large quantities for use against the Germans after their attempt to drive the Canadians from Ypres in 1915 by means of poison gas.

Perhaps the most striking property of chlorine is its powerful bleaching action. Indigo, coloured cloth and most inks are readily bleached by it. Its use for bleaching is somewhat restricted by the circumstance that it is liable to attack the fabric which carries the dye. In the complete absence of moisture it does not bleach at all. If a vessel be filled with chlorine which has been dried by exposure to sulphuric acid, and then a piece of dry red turkey twill inserted, the colour will remain.

An interesting experiment may be performed by spilling ink on a piece of newspaper or other printed matter. On putting the paper into chlorine, the obliterated words will reappear, because the ink will

* Antimony is a very brittle metal and can easily be powdered.

which may be tested with a glowing splint of wood. The residual liquid contains no chlorine, merely a little hydrochloric acid. It can be tested with litmus and with magnesium. Chlorine + hydrogen oxide = hydrogen chloride + oxgyen.

At the present time most of the chlorine of commerce is sold in the form of "*bleaching powder*" or "*chloride of lime*."

This solid is made by exposing slaked lime to chlorine gas. It must be preserved in air-tight vessels, because even the carbonic acid from the air decomposes it, liberating chlorine. A good sample contains from 36-38 per cent. of "available" chlorine, i.e. chlorine which is easily set free.

Equivalents.—The results of a chemical analysis may be stated in more than one way, although in practice they are usually given in percentages. Thus we have found the composition of

water by weight to be 1 part of hydrogen with 8 parts of oxygen, but these figures may be easily manipulated to express the percentage composition. Since 9 parts of water contain 1 part of hydrogen, 1 part of water will contain $\frac{1}{9}$ part of hydrogen, and 100 parts will contain $\frac{100}{9}$ or 11·11 parts of hydrogen and (by difference) 88·99 parts of oxygen.

It is sometimes more convenient not to adopt the percentage method. The Law of Multiple Proportions would probably have been discovered earlier than it was but for the universal custom of stating results in parts per hundred.

If the composition of the two oxides of copper be written down in this way, the simple relation existing between the weights of oxygen which unite with the same weight of metal is not apparent. When we are dealing with the combination of elements, a much better insight into their relative combining powers is obtained by referring all weights to that of a standard weight of one element. It is immaterial which element and what weight of it be chosen, but by common consent the unit or standard adopted is one part by weight of hydrogen, and the weight of any other element which combines with, or sets free, this amount of hydrogen is called its "combining weight" or "equivalent."

Since the composition of every compound is fixed, it follows that every element which enters into chemical combination has a fixed combining weight; and in those cases where two elements unite to form more than one compound there will be more than one equivalent.

Applying the above definition to the combination of hydrogen with oxygen and with chlorine (Experiment XLII.), we conclude that the combining weights of oxygen and chlorine are 8 and 35·5 respectively. The number of elements which combine with hydrogen is very limited, but a large number of metals displace it from acids, and the majority combine with oxygen and with chlorine; and in each case the combining weight can be readily deduced.

In Experiment XX., Part I., page 339, we found the volume of hydrogen liberated from acids by certain metals, and if we are given the density (i.e. the weight of a given volume) of hydrogen under the conditions of the experiment, it is a simple matter to calculate the combining weight of the metal in question.

The weight of a litre of hydrogen at 0° C. and 760 mm. pressure is 0·08995, but no serious error will be made if the figure 0·085 be taken to express the density under average conditions. It was found that 1 gram of zinc displaces 370 c.c. of hydrogen. Since 1000 c.c. of the latter weigh 0·085 g., therefore 370 c.c. weigh $\frac{370 \times 0{\cdot}085}{1000} = 0{\cdot}031$ g. Therefore since 0·031 g. of hydrogen is liberated by 1 g. of zinc, 1 gram of hydrogen would be liberated by $\frac{1}{0{\cdot}031}$ = 32·3 grams of zinc. The combining weight of zinc is accordingly 32·3; more accurate work gives 32·5.

In a similar manner the combining weight of magnesium is found to be 12, and the same value is obtained when we calculate the weight of it which combined with 8 parts of oxygen in Experiment VII., Part I., page 147.

Since 0·65 g. of oxygen combined with 1 g. of magnesium, 8 g. of oxygen would combine with $\frac{8}{0{\cdot}65} = 12{\cdot}3$ g. We may summarise our results thus:

1 part of hydrogen combines with 8 parts of oxygen.

1 part of hydrogen is displaced by 12 parts of magnesium.

8 parts of oxygen combine with 12 parts of magnesium.

The meaning of the term "equivalent" will now be clear. As regards the power of combining with or setting free hydrogen, 8 parts of oxygen are equivalent to 12 parts of magnesium; and 8 parts of oxygen combine with 12 parts of magnesium to form magnesium oxide.

Equivalents of elements are the weights of them which replace one another in chemical changes.

Another indirect method of finding an equivalent is afforded by the fact that certain metals will displace other metals from solutions of their compounds—a type of chemical change known as substitution.

If some zinc be immersed in a solution of copper sulphate, it gradually goes into solution, the colour of the copper compound disappears, and metallic copper falls down, or is "precipitated," as a reddish-brown powder.

Zinc + copper sulphate = copper + zinc sulphate.

Fig. 20.—To find the equivalent of copper by precipitation with zinc.

If the weights of zinc and copper are measured, their relative equivalents can be at once deduced; and if the hydrogen equivalent of either be known that of the other can be easily calculated.

Experiment XLV.—*To find the equivalent of copper by precipitation with zinc* (*equivalent* = 32·5).

From 0·5–1·0 gram of zinc is weighed out and then immersed in a solution of copper sulphate contained in a small basin which has been previously weighed. The liquid is slightly warmed and stirred.

When the zinc has disappeared and the copper has taken its place the liquid is carefully poured off, together with any particles of carbon which may be floating in it. The copper is washed several times with water, the latter being poured away each time. Finally, to assist the drying, the copper can be washed with alcohol or methylated spirits, and the dish is then put in an oven at about 90° C. until the drying is complete. It is then weighed again. To take an example:—

0·580 g. of zinc precipitated 0·567 g. of copper

∴ 1 g. of zinc precipitates $\frac{0{\cdot}567}{0{\cdot}580}$ g. of copper

∴ 32·5 g. of zinc displaces $\frac{32{\cdot}5 \times 0{\cdot}567}{0{\cdot}580} = 31{\cdot}77$ g.

of copper. The correct figure for the equivalent of copper is 31·5.

Similarly zinc will precipitate lead; iron, magnesium and aluminium precipitate copper; and mercury, silver.

E. H. T.

HEAT.—XI

48. Work and Energy.—When a body at rest is set in motion, or when a body already in motion has its motion changed, we ascribe the cause of the change to what we call a *force*, and a force may be defined as that which produces or tends to produce a change in the motion of a body. The force may arise from many sources—gravitation, muscular effort, and so on; and it may be measured in suitable units dependent on the mass moved, and the change of motion produced. A convenient and easily-understood unit for our purpose is the pound-weight; i.e. the force which causes a mass of a pound to move towards the earth's surface with the uniformly increasing speed of 32 feet per second every second. A force may or may not cause the body acted on by it to move; if it does not, there must be an equal force acting in the opposite direction which neutralises its action. When a force does cause the body it is acting upon to move, it is said to do *work*; and the work done is measured by the product of the force into the distance moved. When, for instance, the force of a pound-weight moves the body, it is acting on one foot, the amount of work done is called a *foot-pound*, and this is the unit of work commonly employed in England. Thus, if a force of one ton weight drags a load 200 feet, the amount of work done is $2240 \times 200 = 448000$ foot-pounds.

Again, when a body is in a condition to exert force or to do work, it is said to possess *energy*. The energy of a body may be due to the fact that it is in motion, as in the case of a moving bullet which can do work in overcoming resistance. This form of energy is known as *kinetic energy*. On the other hand, a weight raised up also possesses energy, from the mere fact of being raised; the simple removal of a support unlocks this energy and it becomes kinetic. This form of energy is called *potential energy*. Now to raise a weight, say, of 20 lb. six feet, requires 120 foot-pounds of work. On allowing the weight to fall, these 120 foot-pounds of energy are recovered by the time the weight strikes the ground. In this simple statement lies the essence of the great fact of physical science, viz. the *conservation of energy*. Energy may be transformed from the kinetic to the potential form, but it cannot be destroyed. The potential energy of the raised weight is equal to the kinetic energy lost in raising it.

But what happens when the moving weight suddenly strikes the ground? It would seem that the energy is destroyed then. But careful experiment would show that both the falling body and the ground become hotter through the concussion. In other words, the energy of motion is converted into that other form of energy, heat; and the heat-energy produced is exactly equivalent to the kinetic energy destroyed. Of course, work may be done in other ways, e.g., by compressing the ground; but the main point will still be true, that the energy expended is exactly balanced by the new forms of energy developed.

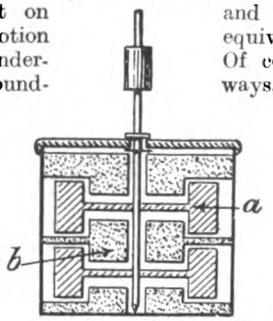


Fig. 64.—JOULE'S CALORIMETER.

Through its lid passed an axle bearing a system of metal vanes (*a*) which could move between corresponding vanes fixed on the inside of the calorimeter.

The reasons why we now regard heat as a form of energy have been pointed out in our first lesson. That it is kinetic is also most probable. The ultimate particles of a gas are conceived of as in rapid motion and vibration; increase this molecular motion, i.e. increase the kinetic energy of the molecules—and the outward effect of this is a rise in temperature. In liquids and solids, though the motion of the molecules is more restricted, it still goes on, and the total kinetic energy of the molecules is the total heat possessed by the body. This is theory; but it is highly likely theory, and in harmony with all experimental facts.

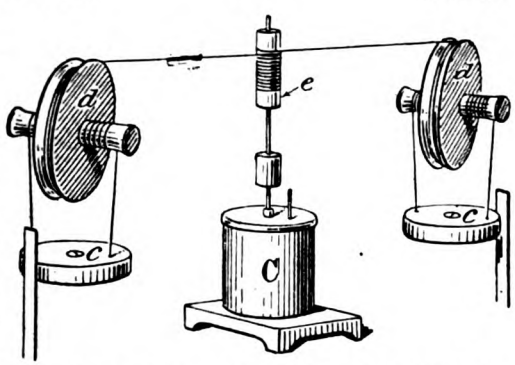


Fig. 65.—Joule's apparatus for determining the mechanical equivalent of heat. The motion of the vanes in the calorimeter (C) (*see Fig.* 64) is produced by two falling weights *c c*, which set in motion the rollers of the pulleys *d d*.

Heat is the least available form of energy, and it is interesting to note that all forms of energy tend to degrade into this most inconvenient form. In all engines, which are nothing more than adaptations for the useful transformation of energy, energy tends to get "lost" — to dissipate itself, that is, into heat which cannot be made useful.

49. Mechanical Equivalent of Heat.—Since heat and other forms of energy are equivalent, it becomes important to measure and define the precise link between them. What is the connexion between the unit of work and the unit of heat?—is the question we have to ask and to settle by experimental means. It was first answered in a satisfactory manner by Dr. Joule, of Manchester, in 1845. He found that 776 foot-pounds of work were expended when one pound of water was raised by it 1° F.

In the metric system, the unit of work is

called an *erg*,* and 42,000,000 ergs are needed to generate a calorie. These numbers, which are, of course, the same thing expressed in different units, give us what is known as the *mechanical equivalent of heat.*

Joule's determination of this quantity is one of the classical experiments in the history of science, but we have not space to enter into his method fully here. He had a brass calorimeter through the lid of which passed an axle, bearing a system of metal vanes (*a*) which could move between corresponding vanes fixed on the inside of the calorimeter (*b*). A hole was left in the lid also for the reception of a delicate thermometer which registered the rise of temperature of the water in the calorimeter. The water equivalent of the calorimeter, vanes, etc., was determined, and the rate of loss of heat by radiation at the observed temperature was also found. Hence, the total heat generated when the vanes were set in motion could be accurately measured. The motion of the vanes was produced by two falling weights, *c*, *c*, which set in motion the rollers of the pulleys, *d d*. These pulleys carried a thin twine which was wrapped double round the roller, *e*, continuous with the axle bearing the vanes in the calorimeter. It can now be understood how the falling weights set in motion the axle, and consequently how the work done by them is converted absolutely into heat. We need not dwell on the devices used to lessen friction, nor upon the experiments by which the little friction remaining was allowed for, nor upon the precaution for the diminishment of the inevitable loss of heat by conduction: these were all satisfactorily managed, and Joule's final result needs very little modification in the light of modern work. The chief defect was the small rise of temperature observed, even when the weights were allowed to fall twenty times, and the heat produced allowed to accumulate. More recent work has aimed at developing larger power and measuring it accurately so that the rise of temperature becomes more rapid.

Other methods of determining the mechanical equivalent have been adopted, but the results are not so reliable. Joule himself tried to make the measurement by allowing compressed air to expand. As the air expands it will do work against the opposing pressure. It will consequently be cooled, for the work is done at the expense of its own inherent energy, i.e. its heat. Thus if the expansion is done against a piston with a known pressure upon it, the work done in moving the piston an observed distance can be calculated. If then the vessel is enclosed in a calorimeter, the heat absorbed can also be found, and the mechanical equivalent obtained. It will be noticed that this assumes that no internal work is done by the gas in expanding, which Joule found by separate experiment to be negligible or non-existent.

The specific heat of air, or other gas, is different when it is measured under the different conditions of constant pressure and constant volume. The heat required to raise a gram of air 1° is greater in the former case than in the latter. For, if the air is allowed to expand, it will do work, and hence require heat, in doing so. The two specific heats having been found, the difference between them is the heat thus expended, and as the work done by the expanding gas can also be calculated, the mechanical equivalent of heat can also be found.

Heat is developed when an electric current passes through a wire. The energy expended in a given time can also be measured when the strength of the current and the resistance of the wire are known. The heat produced in a given time t can be measured in a calorimeter, and the mechanical equivalent of heat (J) is then calculated from the equation $JH = C^2Rt$, where C and R measure the current and resistance respectively in absolute electrical units.

The final result obtained from a careful comparison of all the best work on the subject gives for J a value of 779 in English units, or about 42,700,000 ergs. E. W. E.

* The erg is the work done when the unit of force, or *dyne*, moves a body 1 cm. The dyne is the force which, acting on a mass of 1 gram, increases its speed by 1 cm. per second every second.

ZOOLOGY.—XI

WE now near the foot of the ladder of mammalian life. We cannot have failed, in descending the rungs, to marvel at the wonderful chain of varying diversified life, infinitude of invention, splendour of efficiency, perfect adaptation to the manifold means of existence, in the crowded city, in the gloomy forest, on the prairie and Savannah, in the sounding seas, up the hillside, in the still valley and in all earth's waste places. Life everywhere, and the mammal pre-eminent, supreme, the fittest yet, and for all human time, with man, puny of physique, but gigantic in intellect, unchallengeable.

Edentates and Marsupials

On this occasion we must with brevity and speed glance at orders, for the study of which the student will find full volumes necessary and desirable. We have for our subject here one group of animals of which representative genera have been specialised almost out of existence; for another, a vaster assemblage which has defied time and progress in regions where time and progress did not count, a group in which, possibly, features of the very earliest mammalian form of life survive, little modified from the wonder-days in which warm-blooded quadrupeds emerged from the ruck of reptile existence.

The first group has been a rare puzzle to zoologists, and they have had to consult the book of the head, that great volume whose chapters consist of buried extinct forms, to place the edentata and fix their station in the plan of Nature. Even now the name of the

order is not satisfactory. "Edentata" is a word which should describe animals destitute of teeth, but edentates include toothed animals, the toothless being the exceptional. The teeth of the entire order are characterised by their simple structure and entire absence of enamel, and highly specialised for the particular phase of life pursued by each family and genera, and so the name must pass. The order comprises the sloths, the ant-eaters, the armadillos, the pangolins and the ant-bears or aard-varks, one of quite the strangest groups in Nature; animals which hook themselves to the boughs of trees and hang sky-gazing back-downward all their days; animals which lack front teeth; animals which thrive without a single functional tooth in the family; and animals which wear armour—true mammals in armour, like that once possessed by greater beasts in days and orders long gone.

Mammals in Armour

To the layman it is difficult to see anything in common between these mammalian parasites of the trees of tropical South America, and the toothless, scale-plated pangolins of the old world, or the great hairy, cylindrical-beaked ant-eater of the New World. How are we to associate the New World's armadillos and pichiciagos, redoubtable and unique in their carapaces of bony plates, with the pig-snouted aard-varks of South Africa, which, unlike their toothless allies, the pangolins, are well equipped with teeth, though, like all other members of the order, destitute of frontal dentition?

A problem indeed, yet finally solved, as has been indicated, by the testimony of animals that have lain a long age dead. In days when giants possessed the land, the mighty megalotherium, or giant ground sloth, vast in bulk as an elephant, and the mylodon, which had the mass of a modern rhinoceros, incorporated the peculiarities of both sloths and ant-eaters; the head and teeth, enormously enlarged, of course, were those of which we find the diminutive replica in the modern sloth; the body, raised to ultimate magnitude was, with the tail, that which the ant-eater of to-day resembles.

The armadillos are the latter-day representatives of an ancient assemblage of creatures which included the glyptodons, mammals enclosed in a carapace from 11 to 12 ft. in length. The glyptodons have perished, but many a time-defying carapace survives, to act as a ready-made hut for the Indians of the Argentine pampas. It is the bony citadel of the ring-tailed, rather than that of the club-tailed glyptodon of which we more frequently hear, and the ring-tailed representative carried upon his back a bony castle only 6 to 7 ft. in length. The most prodigious of the glyptodons had certain of the many bones of the carapace pierced to permit the outgrowth of bristles, like the hair of the existing hairy armadillo, but in this case the bristles were thick as the quill of a big feather.

The tail of this creature was a masterpiece of grotesque and fantastic natural architecture. Defended at its base by half-a-dozen bony rings of a diameter equalling that of the middle hoops of a beer barrel, the terminal half of the appendage was formed of one massive cylindrical bone, which, says the late Mr. Lydekker (to whose description of the glyptodon this chapter is indebted), if we exclude whales, is one of the most massive bony structures in the animal kingdom, and is almost as much as a man can lift. Along the sides of this huge depressed flattened club remain evidences to indicate that during life huge horns projected at right angles to the tail. Such an abnormality could not have been for defence, for the bony structure of the tail itself was alone sufficient to defy attack, as was the carapace to ward off danger of attack from carnivorous foes. No, the presumption is that adornment was the end sought.

Fatal Giantism

This is development run mad, and with the preposterous zenith attained, the genus perished. Fatal giantism again; giantism in general over-growth of body and defence, giantism of special features. This factor had proved fatal to the order of the stegocephalia. The giant stegosaur, herbivorous and bony, was an easy prey to the much smaller carnivorous dinosaurs.

The glyptodons were the cousins of the armadillo. Pigmy glyptodons started out pretty much in company with the early armadillos. Dental and other characters show the two animals to have arisen with sloths and ant-eaters from a common stock. The greatest have gone; the armadillos, some with segmented harness, enabling them to curl up like a hedgehog or wood-louse, some defended and restricted in outline by a cuirass a yard in length even to-day, these survive, adapted to the life of the treeless pampas and areas north and south of the Argentine. And as we trace the relationship of armadillo and glyptodon by the teeth, so we find relationship and affinity between these ancients and moderns to the sloths. The

same defective dentition characterises both, the same absence of frontal teeth, the same lack of enamel on such teeth as have survived the forceps of time.

The megalotherium was another very considerable beast, 18 feet in length, several tons in weight, standing erect, or squatting upon haunches whose bones make those of the elephant comparatively insignificant, with hind feet a yard in length, and designed upon lines so powerful as a whole that whereas the arboreal sloths went up the trees to feed, the ground-sloths pulled down trees for the like purpose, perhaps digging about the roots to loosen the soil, then hauling down the forest growth bodily by means of their tremendous grasping fore feet and claws. Yet these Titans arose from ground-sloths no larger than the smallest of existing tree-sloths.

Photo: W. S. Berridge, F.Z.S.

PROECHIDNA, OR SPINY ANT-EATER.
a three-toed egg-laying mammal. It has a covering of hair which is reinforced by sharp spines.

It is strange that we can trace the association of primeval man with three of the old-world giants—the mammoth, the glyptodon and the megalotherium. Drawings, crude and inartistic enough, of living glyptodons, have been found in the caves of the Argentine and Brazil, while ancient implements have been brought to light, buried side by side with glyptodon remains. There is the clearest proof that ancient men domesticated the giant sloth, kept it penned in pre-historic Patagonian caves. There lie, or did lie, the remains of men, and the remains of giant sloths, not merely bones, but parts of the skin with its shaggy hairy covering, like that of the modern sloth and ant-eater, but with bony nodules, bean-sized, buried in the outer surface of the hide. And in these old-time stables lay the hay, cut ages ago, as food for these most monstrous of pets—or were they the edentate milch-cows of those far away unknown men?

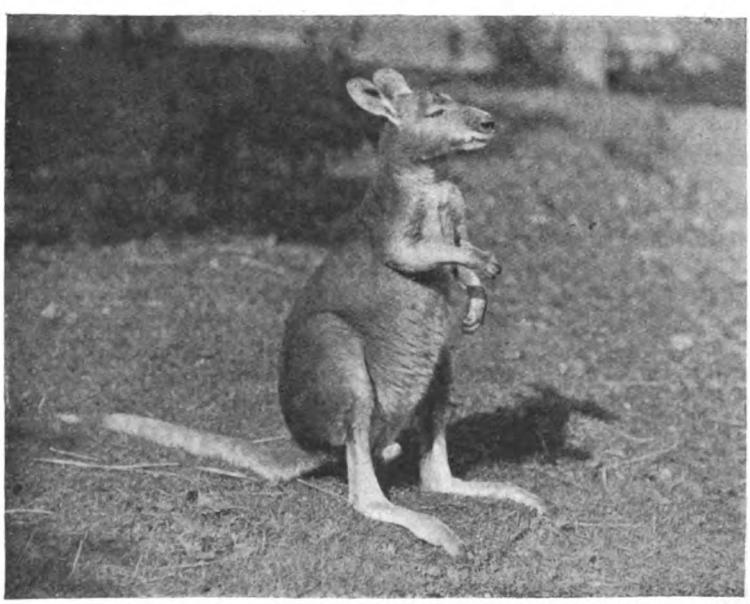


Photo: F. Martin Duncan.

THE KANGAROO.
The offspring of a man-sized Kangaroo is no bigger at birth than one's thumb. The tiny embryo is placed in the mother's marsupium or pouch, where it is fed automatically at the will of the mother.

One of the most perplexing of problems is that of the disappearance of the hordes of giant animals which once peopled the plains of South America, but the fact that man was con-

temporaneous with the glyptodon and the ground sloth and knew himself as their master, suggests a possible clue to an auxiliary channel along which these strange mammalian lives would ebb away.

Two steps more and we have completed our descent of the ladder of life among the mammals. We come to the marsupials and monotremes. We already know the conditions which an animal must fulfil to rank among the mammals. One other has to be noted. The young of mammals in general are highly developed as they enter the world. But we know that in ancient days Nature had not achieved this plan. The young were born when very immature, and, still earlier, they appeared merely as minute specks of life enclosed in an egg. The first of mammals were hatched from eggs, like the young of reptiles, birds, fishes and amphibia. In a later stage the ovum matured within the body of the female parent. The record of both processes seems to be preserved for us by the life story of existing marsupials and monotremes; the imperfect form of the newborn marsupial, the egg of the monotreme.

So far, definite unquestioning assertion. But an addition must be made. Among the marsupials, the pouched mammals, we have, in the bandicoots, animals whose internal organism suggests that they, in common with the generality of mammals, have produced more highly organised young than those characteristic of the marsupial order. This leads our school of thought to infer that the bandicoots preserve vestiges of features once common to their entire order. If that were the case, then we should have to say that the marsupials do not typify the general mammalian habit of old-time, but are degenerate; that they are not unchanged descendants of the ancestral stock, but have ceased, through degraded specialisation, to produce well developed young. In the present state of knowledge it is unsafe to dogmatise. The bulk of opinion inclines to the view that marsupials are primitive unreformed mammals, but the views of those who maintain the contrary theory, and plead degeneration, are those of men not lightly to be disregarded. With this warning the student may pursue investigation for himself, for the last word upon the subject has not been written.

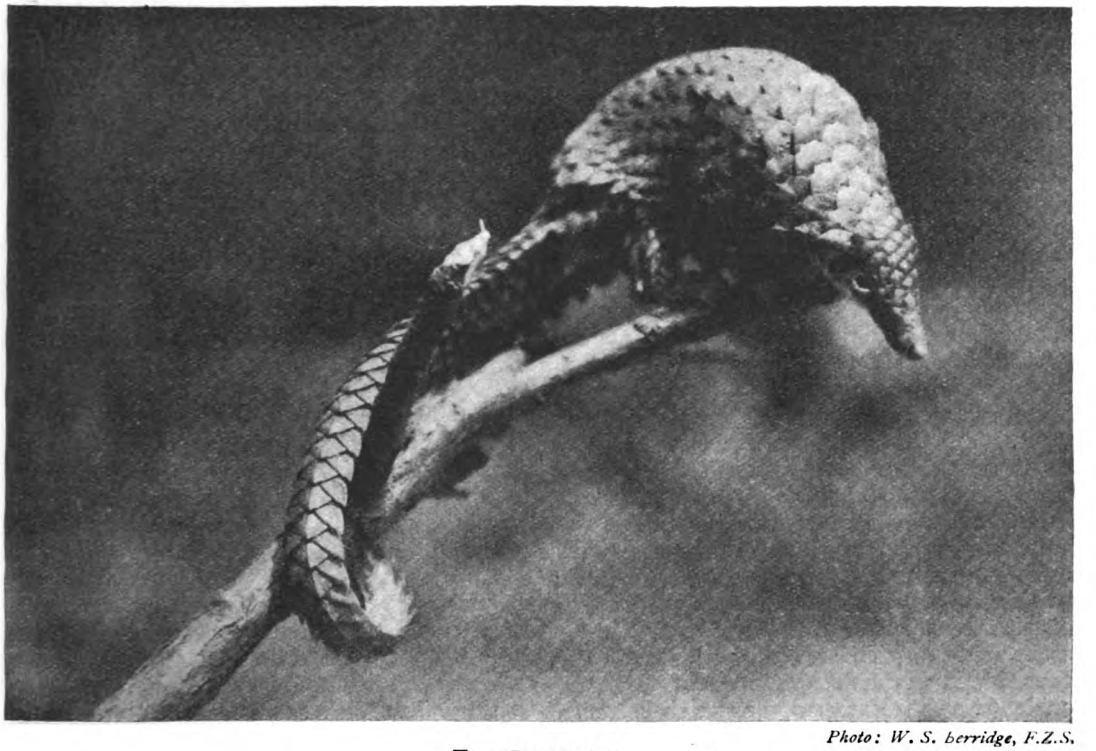


Photo: W. S. berridge, F.Z.S.

THE PANGOLIN,

found in tropical Africa and Asia, is a toothless scale-plated mammal, armed with powerful claws, with which it tears up nests of termites or "white ants"—its favourite diet.

The marsupials are confined with the exception of the true opossums, and the selvas, to Australia, New Guinea and the adjacent islands as far west as Celebes and Lombok. The exceptions are most numerously represented in the northern half of America. In tertiary days marsupials were widely distributed over Europe; earlier still their range was almost world-wide. Now the belief of those who regard the marsupials as primitive unchanged animals is that these Australasian stock of to-day descend from an ancestry of animals world-wide in distribution, members of which reached the southern world when there existed land connections between South America and Australia. The land bridges sank, and the isolation of Australia delivered an enormous area into the possession of a group of animals between which competition was not so fierce as that between other orders in lands where diverse developing types waged relentless and incessant war.

Australia evolved only one true carnivorous form, the thylacine, or Tasmanian wolf, but this, strange to say, with no rival to contest its claim to unlimited prey among its herbivorous marsupial relatives, died out utterly on the continent and lingers only in Tasmania and lesser islands. It is true that among the phalangers we find insect-eaters and animals of carnivorous habits, but with the exception of the Tasmanian wolf, as we now call this insensate brute, Australia had not a true carnivore. That wild dog, the dingo, is, of course, a member of a different order, and though his remains are said to have been found in fossil form in Australia, the evidence is not clear, and in any case he was a later arrival than the marsupials.

Pouched Animals

With a continent as their sanctuary, the pouched animals developed in Arcadian security and peace. We are not to assume, of course, that they reached their haven as a few genera and species and became many. The inference, on the contrary, is that the resemblances between marsupial and placental animals is not proof of distinct and separate origin, but rather of parallel development from a common origin. The great kangaroos and their allies, the wallabies, take the place of normal herbivores among more highly developed mammals. Different as is their structure, some of the so-called rat-kangaroos suggest hares and rabbits, as also still more so do the bendicosto. We find in the order the prehensile tail which distinguishes New World monkeys. The rat, the mouse, the dormouse, the mole, the flying squirrel, the pen-tailed tree-shrew all seem to have their counterpart among the marsupials; predaceous so-called cats are members of the same group; the wombat is among marsupials the duplicate of a burrowing rodent; the koala is sufficiently like a small bear in outline and tree-climbing habit to be called the Australian bear.

So far as can be discovered, Australia had no marsupials at a time when they flourished in Europe and North America; to-day Australasia is their stronghold, yet in spite of unending stress and struggle, two representatives of the order maintain their hold in America. That is the case for the relationship of the marsupials to the outer world of mammals—for the theory that rodents, insectivores, herbivores and what not, evolve from one common stock of which the marsupial is the oldest surviving and that but for the surging tides of progress which carried the mammalian physical organisation higher and higher, the British rat might have become a rat, and yet have remained, like its Australian namesake, a marsupial.

Monotreme: Mammal or Reptile?

Lowly as is the development of the marsupials, yet it raises those animals infinitely above the level of their predecessors. The whole plan of a marsupial's life implies affection, absorbing care for the young.

The young, indeed, are born incredibly helpless, impossibly imperfect. The offspring of a man-sized kangaroo is no bigger at birth than one's thumb. It is practically a larva, and has to be placed, a tiny pulsating embryo, in the marsupium or external pouch of the mother, not to suckle, for it is too helpless for that, but to be attached to a teat which automatically, at the will of the mother, projects milk down its throat. So impotent is the offspring that the windpipe has to be continued to the rear of the nostrils so that there may be no opening from the mouth into the lungs by which milk may enter and suffocate it. In the marsupium the little one develops size and strength, and does not leave it until it is able to run and feed itself. Even then at a sign of danger it returns to the protecting cradle, to be borne to safety by the far-leaping mother. The marsupial pouch of two representatives of the order has been discarded, but even so the same immaturity marks the young at birth, and the prehensile tails of the young opossums, coiled around that of the dam, serves the thriving little one as the pouch serves the young kangaroos or thylacine.

Then there is the lowest step of all, the monotremes, the members of which lay eggs. There are two families, of which the ornithorhynchus or duck-billed platypus constitutes the first; and the five-toed echidna and the three-toed proechidna, the two genera of the second. Here we reach the stage at which the dividing-line between mammals and reptiles becomes extremely fine, while some characters are obviously bird-like. The monotremes are, of course, warm-blooded, but their temperature varies, and in the echidnas sinks more than a dozen degrees below that of other mammals. They are hair-covered, but in the echidnas the hair is reinforced by sharp and thick spines. The duckbill is a compendium of incongruities. As the name connotes, it has a bill like that of a duck, but this is not horny and insensitive, but clothed with a smooth skin in which numerous tactile nerves terminate. While the young have teeth, the adult is furnished with toothless serrated boring jaws. Its feet seem anomalous, webbed in front, like those of a seal, but with the web extending beyond the toes. The body is like that of a large mole; the tail like that of a beaver. The duckbill's egg is laid in a burrow and then brooded like the egg of a bird. After hatching out the young are suckled in the ordinary way.

The echidna, however, when she lays an egg, places it, by means of her mouth, in her nursing pouch. There the little one eventually emerges, forcing open the shell of the egg itself, and obtaining milk from its dam while young within the pouch. The platypus is a water-haunting animal and obtains its food at the bottom of slow still waters. The echidnas feed on ants, the five-toed exclusively, the proechidna partly, and to this end are armed with claws and long tongues.

There the story of mammalian life terminates. It could go no farther, for below the monotremes come the birds and reptiles. We have thus covered in a descending scale the whole scheme of the foremost order in life.

E. A. B.

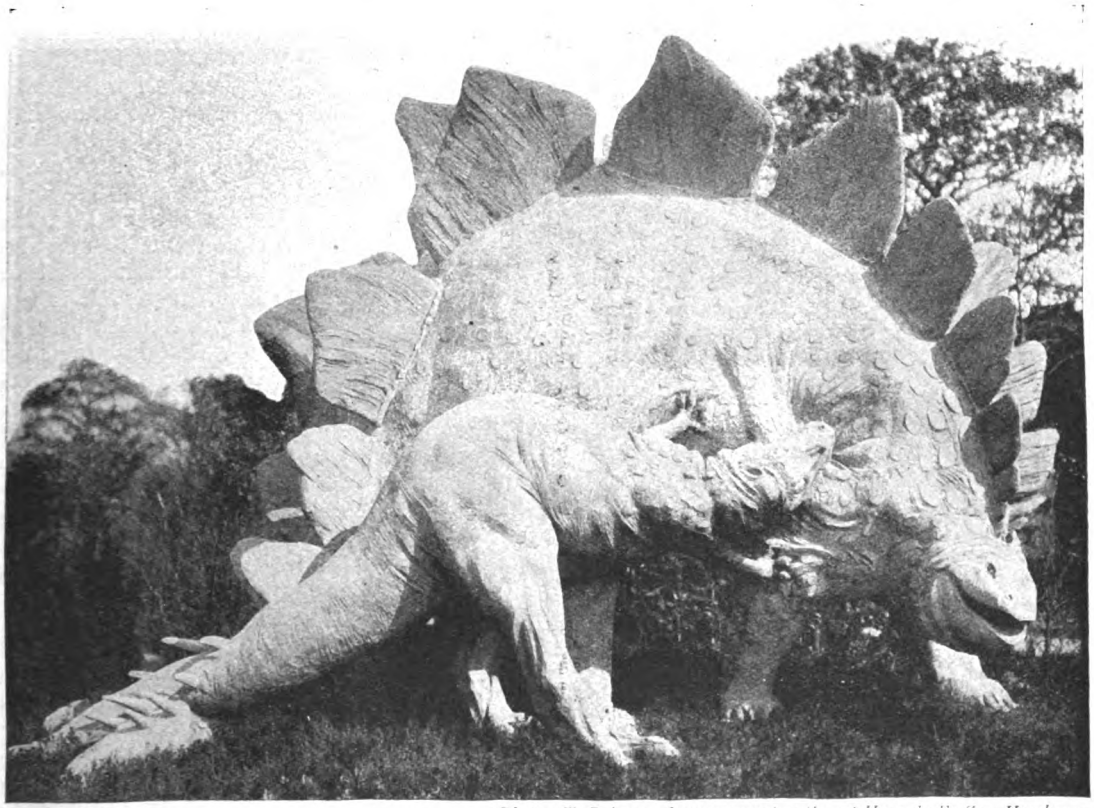


Photo: T. Reimers, from a reconstruction at Hagenbeck's Zoo, Hamburg.

THE MEGALOSAUR ATTACKING THE GIANT STEGOSAUR.

In the struggle for existence giantism proved a fatal handicap. The big bulky stegosaur, herbivorous and bony, proved helpless against his smaller but carnivorous rivals.

ASTRONOMY.—XII

THERE is considerable reason to believe that the Great Pyramid was so constructed that a long, sloping passage in its interior pointed up to the Pole star of that time, and some people have considered that the building itself was used as an observatory. It does not seem certain, however, that this peculiarity of its construction means anything more than that extreme care was taken to get the orientation of the building precisely square to the four cardinal points, in which the builders were extraordinarily successful.

Observatories: Ancient—

Hipparchus and Ptolemy and other great astronomers of their age used instruments, but nothing very much is known of special buildings devoted to their use, and perhaps they had not anything like an observatory in the modern sense. The Persians and the Arabs did construct somewhat elaborate buildings for astronomical observations, especially, it would seem, large and complicated sundials, but we have not very much account left of what they were like.

The earliest observatory which resembled the large national observatories to-day was that built by Tycho Brahe upon the Island of Hven (see p. 147). To this man we owe both the conception of the observatory and of many of the instruments with which it was fitted. His original genius made so great a revolution in the art of observing that he is properly considered to be the founder of modern observational astronomy, although he lived before the days of the telescope.

THE LICK OBSERVATORY

stands on the summit of Mount Hamilton in California—an almost ideal position for an Observatory, the atmospheric conditions being probably the finest in the world.

Not so long after his day the Royal Observatories of Greenwich and of Paris were founded — the first national observatories. It is generally said that we owe the foundation of Greenwich to the fact that a certain Frenchman arrived at the Court of King Charles II. with a plan for determining the longitude at sea, which had two principal defects. It was not a new plan, and it was not practicable, because the places of the moon and the stars were not sufficiently well known. To remedy this latter defect King Charles gave orders for the foundation of the Royal Observatory, and the octagonal building designed by Sir Christopher Wren for the new observatory is still a conspicuous feature of the well-known group of buildings to be seen on Greenwich Hill.

The functions of a national observatory are to carry on continuously the long series of observations of the sun and the moon and the planets and the places of the stars, which must be made, but which are rather dull work, and which cannot be left safely to the enterprise of Universities or of individuals. This is a well-recognised principle; but it may be said without boasting that Greenwich is the only national observatory that has kept up this kind of work unfailingly during the whole of its history. "All future conclusions as to the laws of motion of the heavenly bodies must depend largely upon it," said Simon Newcomb in his "Reminiscences of an Astronomer."

—and Modern

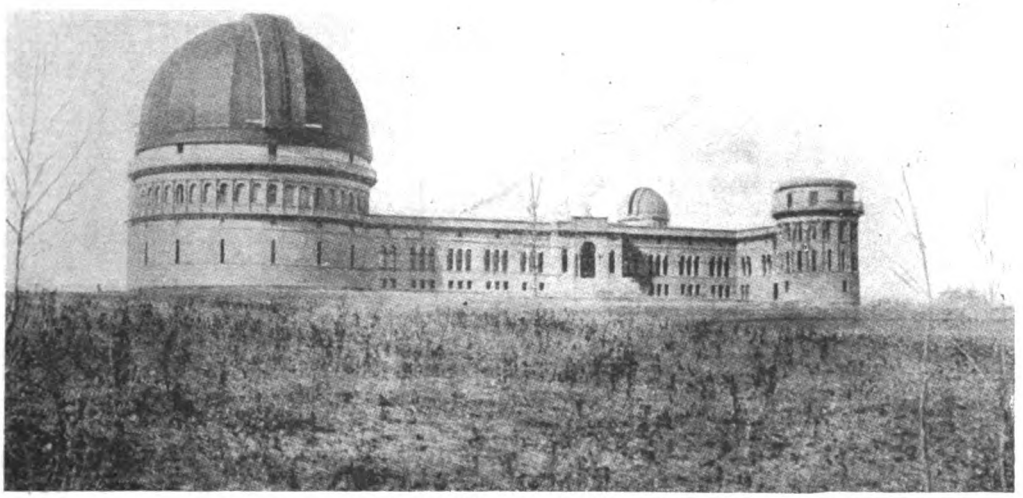
The instruments required for this fundamental work are not very large, and the results are not very showy, though they make a very bulky annual volume. There is, therefore, some tendency to under-estimate such work in comparison with the work of discovery carried on with the immense equipments of more modern observatories, especially those in the United States. The possession of the largest telescope in the world puts its owner into the position of being able to do unique work; but it is not the kind of work that need be endowed by the State.

And so it has generally been the case that the biggest instruments belong to the University or the private observatories rather than to the national. Thus for some years the largest refractor belonged to Mr. R. S. Newall, of Gateshead, and to-day the Yerkes Observatory of the University of Chicago possesses in the 40-inch refractor what is likely to remain for some time to come the largest instrument of its kind.

Large reflectors have usually been private possessions constructed by their owners themselves. William Herschel's four-foot reflector was built by him for the King's Observatory at Windsor. Fifty years later Lord Rosse built his six-foot reflector at Parsonstown; and somewhat later Lassell erected his four-foot reflector at Liverpool and then at Malta. About 1879 the late Dr. Common made a great step in advance with his five-foot mirror at Ealing. The largest and most perfect instrument of the kind at work to-day belongs to the Solar Observatory on Mount Wilson in California, maintained by the Carnegie Institution.

A national observatory will almost inevitably be placed in the immediate neighbourhood of the capital city, and this in itself to some extent militates against its work, for the conditions of atmosphere are necessarily by no means ideal in such places. It has become the fashion of late years to agitate for the removal of such observatories to conditions more promising, yet there is very good reason to doubt the wisdom of such a course.

Certain lines of work undoubtedly must be pursued under the finest condition of atmosphere, and these are now admirably provided for at such places as Mount Wilson, or the Lick Observatory on Mount Hamilton, also in California; or at the Indian Government Observatory of Kodaikanal, 7,000 feet up in the hills of the Madras Presidency.



THE YERKES OBSERVATORY
of the University of Chicago possesses a 40-inch refractor, the largest instrument of its kind in existence.

The astronomers of those distant observatories work under great advantages of climate, but under very considerable disadvantages in their absence from the society of other scientific men, and in their want of many of the ordinary conveniences of the town. It is probable that the fashion for moving observatories far away into the wilderness has gone far enough; at least it is almost certain that the habit of moving to mountain tops has gone too far, and that broad, high valleys may be found which offer better conditions of atmosphere as well as habitability.

The two most famous observatories of the British Empire are those maintained by the Admiralty at Greenwich and the Cape. We have already pointed out the special duty of Greenwich. Without neglecting this fundamental work it has been able within the last few years to get its equipment enormously improved by the addition of the great photo-

graphic refractor and reflector given by Sir Henry Thomson, as well as by the 28-inch visual refractor and the astrographic refractor which are of somewhat earlier date.

Next in order come the twin establishments of the Cambridge Observatory belonging to the University, and the adjoining Solar Physics Observatory, which belongs in large part to the University, but is supported by the British Government. These two observatories together have a range of equipment somewhat wider than that at Greenwich, but have not the great strength of staff which produces at Greenwich such an enormous output.

It is not easy to place in order the other British observatories. The Radcliffe Observatory at Oxford, a distinct foundation independent of the University, possesses a very fine photographic telescope, more elaborately equipped than any other in the country. The Royal Observatory at Edinburgh occupies very fine new buildings on Blackmore Hill, and has one of the finest astronomical libraries in the world, the gift of the late Earl of Crawford. The University Observatories of Oxford, Durham, Glasgow, and Trinity College, Dublin, are smaller institutions specialising in different lines and each possessing at least one instrument of distinction. The Observatory of Stonyhurst College nobly maintains the traditional devotion to astronomy of the Society of Jesus.

The Victoria Telescope

The finest observatory in the Empire, and certainly one of the best in the world, is the Cape Observatory, which, under the enthusiastic directorship of the late Sir David Gill, has become equipped with a remarkable number of instruments of the first class. Its new transit circle is unique in its wonderful installation of subsidiary equipment—collimators and azimuth marks. Its heliometer is not only the finest of its kind, but is doing unrivalled work. The great Victoria telescope, the gift of the late Mr. Frank McClean, has a spectroscopic equipment of unsurpassed completeness.

Of the observatories belonging to the British Dominions beyond the seas, the Dominion Observatory of Ottawa and the Union Observatory of Johannesburg have done first-rate work in the few years since their establishment. The Indian Observatory of Kodaikanal is essentially a solar observatory, working in co-operation with the meteorological department at the all-important problems of the relations between solar and terrestrial activities. The four observatories in the Commonwealth of Australia have done good work with somewhat limited means ; and it is good news that a gap in the chain of solar observatories round the world is to be filled by New Zealand.

Of foreign observatories we can name but few of the most famous. Foremost among them is the Imperial Russian Observatory of Pulkovo, the home of instruments and methods of precision. No observatory has played a greater part in laying solidly the foundations of stellar astronomy. The Paris Observatory is famous for its long line of distinguished directors, and for the great part it has played in the establishment of photography in the methods of the astronomer. The Imperial Observatory of Vienna is unsurpassed in magnificence, and has a very fine telescope built by Grubb, of Dublin. Berlin and Potsdam, Koenigsberg and Bonn and Heidelberg have all been the homes of famous astronomers and have contributed much to the general stock of knowledge.

American Observatories

The observatories of the United States have been increasingly prominent for their magnificent equipment and for the striking character of their discoveries. The 36-inch refractor of the Lick Observatory on Mount Hamilton marked a considerable advance in size and design, and it has been specially prominent in the most refined lines of spectroscopic work. Its neighbour, the newer Solar Observatory of the Carnegie Institution on Mount Wilson, above Pasadena, was instituted primarily for solar research, and has been able to include much else in its endeavours after "logical completeness." Its conspicuous instruments are the superb 60-inch reflector and the highly original long-focus instruments for every kind of spectroscopic investigation of the sun.

The Yerkes Observatory of the University of Chicago has one great instrument, the 40-inch refractor, which is the largest in the world. It is remarkable for the variety of work—micrometric, photographic, and spectrographic—which is carried on by different men with the same instrument.

The Observatory of Harvard University is remarkable in another way. Its instruments are not of extreme size or cost, except, perhaps, for the Bruce telescope, which is mounted at the southern station at Arequipa. The special feature of this observatory is its enormous stock of photographs, continually amassed by four or five instruments, and with the aid of its southern station covering the whole sky from pole to pole. A. R. H.

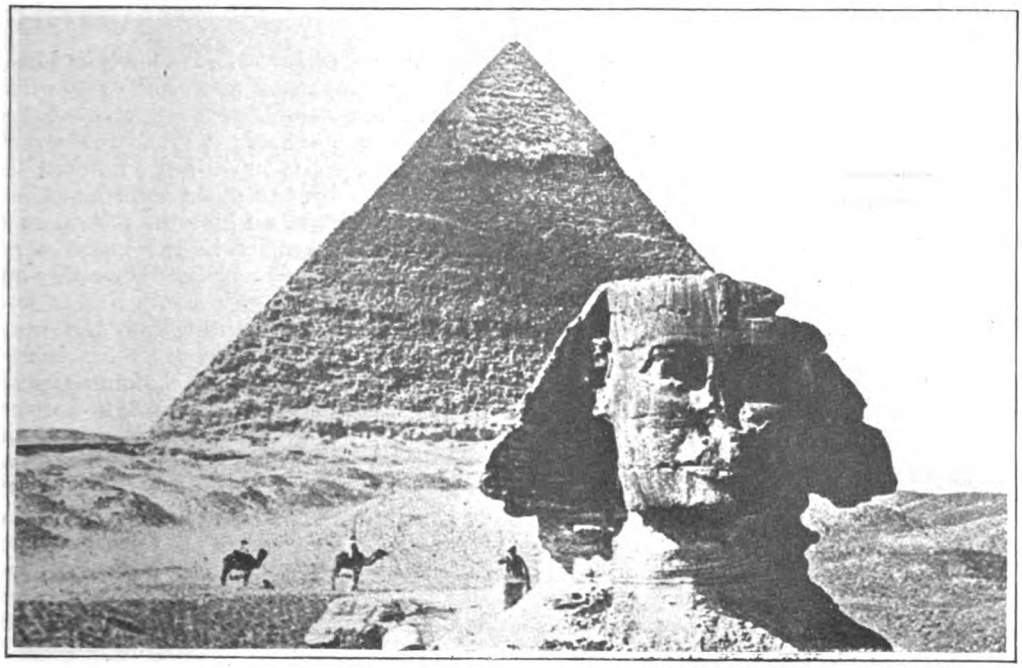
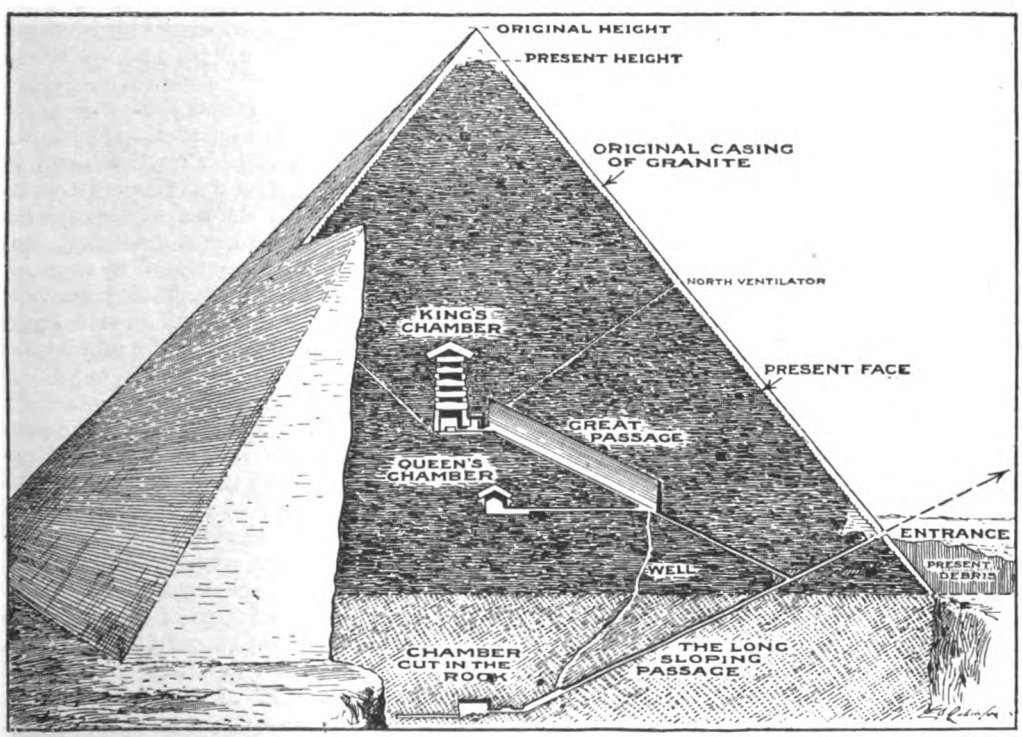


Photo: Underwood and Underwood.

THE GREAT PYRAMID OF CHEOPS

shown above (with the Sphinx in the foreground) was probably used at one time as an observatory. As can be seen by reference to the diagram below—



Drawn by W. B. Robinson.

—from a chamber cut in the rock at the base of the pyramid runs a long sloping passage which without question pointed to the Polar Star at the time when the pyramid was constructed. This of course may merely be proof of the extreme care that was taken to get the orientation of the building square to the cardinal points.

ANTHROPOLOGY.—IV

THE world, as we have seen, is populated by five distinct races or sub-species of Man. These may be classified as follows:—

(1) The Caucasian, White or European man, the overlord of all.
(2) The Mongolian or Eskimo.
(3) The Amerindian.
(4) The Australoid.
(5) The Negro.

(1) *The overlord of all, the Caucasian, White or European man.*—A type formerly known as "Caucasian," but which might well be called in scientific definition *Homo sapiens europaeus*, for he has been emphatically a development of Europe. His principal subdivisions at the present day are the blond or Nordic type characteristic of a good deal of the British Islands, of Northern France, Belgium, Holland, Germany, Scandinavia, Central Russia, and portions of the Balkan Peninsula, Switzerland, Northern Italy, Northern Spain and Northern Portugal.

A very similar type with brown, reddish or yellowish hair and grey eyes also occurs in parts of Morocco, Eastern Algeria and Western Tunis, and even existed, it is believed, at one time in Northern Egypt and in the mountains of Abyssinia. It also occurs in very similar form in Western and West-central Asia (Afghanistan, Armenia, Caucasia, and Syria). The Mediterranean type of White man has dark-brown or black hair, brown eyes, and a tendency to a slightly tinted skin colour, a tinge which deepens into yellow and brown in most parts of North Africa, Egypt and Northern India.

The Nordic, or Fair-haired, Man

The Nordic or fair-haired type seems, so far as we can guess, to have been closely associated in ancient times with the origin of the Aryan languages and Aryan culture, somewhere on the borders of Europe and Asia, in what is now the Russian Empire; on the other hand, the Mediterranean or dark-haired type has in more recent times been identified specially with the Dravidian languages of India and tongues of similar structure in the Caucasus (a type of language which may once have preceded that of the Berber in North Africa and have left its traces in the Basque of Spain); and with the Hamitic and Semitic languages, for long the dominant speech forms of North and North-east Africa, Arabia, Syria and Mesopotamia.

The European man early in his development seems to have had a certain kinship with the Australoids who are now to be met with in Australia and southernmost Asia. With them he shares a great tendency to hairiness of body, much more marked than is the case with the other varieties of Man. But he developed on his own account a big bony nose, especially in the male, a high facial angle (he has always been the most beautiful human being according to accepted standards of beauty throughout the world), and comparative absence of skin pigment.

Not long after he had become (perhaps in the Cro Magnon * form) the dominant race of Europe, his instinct of wandering and colonisation carried him right across Asia to the Far East, where he has left his descendants in the Ainu of Japan; and southwards through India to Cochin China, Sumatra, the Malay Archipelago and the Pacific islands, where his much crossed and modified descendants may be met with in the Maori of New Zealand, in the Polynesians of the Pacific, and the Indonesians of Malaysia. He may even have pushed into Africa many thousand years ago, reaching to its southernmost extremity, leaving his vestiges there in the big-brained cave-dwellers and craftsmen known as "Strandloopers."

Round Skulls

(2) *The Mongolian or Eskimo.*—Possibly this type or sub-species of Man, with singularly straight, black hair on the head, comparative absence of hair on the body, narrow, slit-like eyes with brown iris, very broad and prominent cheekbones, a narrow, sunken nose, and yellow skin-colour, is seen in its most primitive and most divergent type in the modern Eskimo of North America and North-east Asia and in the allied peoples of Northern Siberia.

The more southern Mongols or Mongoloids, such as the Amerindians of America, the Japanese, Chinese, Tibetans, Malays, Turks, Tatars and Finns, are characterised by the round shape of the skull †; whereas the Eskimo, like the primitive European, the Australoid, the Negro and extinct species of man is dolichokephalous or long-headed.

The round-headed type of man may have arisen in Eastern or Central Asia, and thence have permeated a good deal of Europe, of Southern Asia and of the two Americas.

* Cro Magnon is the name of a cave in the Dordogne, France, where were first discovered the skulls and skeletons of a tall race with long skulls of fine cranial and facial development.

† In science the very round-skull peoples are called brachykephálic, and those that are neither markedly long-headed nor round-headed, "mesatikephálic."

The Mongolian or Mongoloid type of man in mixed forms is found still in Scandinavia under the name of Lapp; in Russia as the Finn; in Hungary here and there as the Tatar-like type of Magyar; in parts of Germany (where it may be descended from Central Asian migrations both ancient and modern); in Ireland, Scotland, and eastern England; throughout Northern and Central Asia, except where the European type survives, from ancient or modern settlement; throughout China and much of Japan (though the Japanese are a very mixed race with ancient White-man and Negrito elements); and in Malaysia.

(3) *The Amerindian.*—There is a remarkable degree of similarity in the general type of American aborigines, when the New World is surveyed from Northern Canada to Tierra del Fuego.

The physical characteristics of the Amerindian type show its kinship with the Mongolian. There is very little hair on the body or face. The head-hair is long and as a rule coarse and straight. If a segment of a hair is cut and magnified it is seen to be nearly round in outline (as it is in the Mongolian), whereas the hair of the European is more oval, and that of the Negro a narrow ovoid, occasionally bent.

The skin-colour in Amerindians ranges from pale yellow to dark reddish-brown, a few sun-smitten tribes being a very dark brown. The iris of the eye is brown. In some forms the eyes are comparatively large and round, like those of Europeans, but the general tendency is for the eyes to be narrow and to develop that overhanging fold of skin at the inner corners characteristic of the Mongolian, and a marked feature in the Chinese.

In fact, many of the aborigines of Central America and western South America are so extraordinarily like Chinese or Japanese in facial appearance that if they were similarly dressed they could hardly be distinguished as a different people. Some of the aboriginal tribes of northern South America have not quite such straight, lank hair as the rest of the Amerindians; it has an underlying tone of dark red in its colour and a very slight tendency to undulate or curl.

As regards skull form, from some other

From a photo lent to Sir H. H. Johnston.

TYPICAL ENGLISHMAN.

The blonde or Nordic type of the Caucasian, White or European Man is characteristic of large portions of Western and Central Europe.

points there are slight indications that the Americas may first of all have been colonised by a primitive Australoid type of man at a comparatively remote period, when there was a land bridge connecting North-east Asia with Alaska, and even intermittent land communication across the northern Atlantic with Scotland.

Man seems to have penetrated into South America at a very early date. Indeed, so far, the oldest human remains found in the New World are found in southern South America !

Yet considering all the factors of the case, especially the absence of any trace of pre-existing anthropoid apes in the New World, we must conclude that the Americas were peopled from North-east and perhaps Eastern Asia and Malaysia, and that North America and Central America must both have been colonised before any human type reached South America.

Geographical Speculations

Of course, it is just possible that South America may have been colonised from Southern Asia very early in human history across the Pacific. A good many of the existing archipelagoes may be only the mountain tops of lands now sunk below the surface ; yet so far there is no geological discovery which leads us to believe that areas of land extended continuously across the equatorial Pacific to connect Australasia with South America.

There is, however, such an extraordinary resemblance in bodily aspect and in the simple arts of life between the indigenes of South America and those of certain of the Pacific islands [and most of all of the great islands of the Malay Peninsula such as Borneo], that we are almost compelled to believe some great change has taken place in recent times in the geography of the Pacific Ocean. There may have been a general sinking of land. If so, we have thereby lost the means of tracing the migration routes.

(4) *The Australoid.*—This in its purest form is the human type which comes nearest to primitive Man, to the human ancestor.

It is of normal stature, neither a giant nor a pygmy race as a rule, with a brown or dark-brown skin, almost black in some tribes ; in any case, much darker than the skin of the Mongol or Mongoloid. There is an abundant growth of head-hair and face-hair (which is not straight as in the Mongol, nor frizzled as in the Negro, but mid-way between, very like the curly hair of Europeans), and more hair on the body than in any other existing human variety.

The eye-pupil is brown, but the eye is in shape like that of the European. The cheek-bones are prominent, the chin is narrow and often retreating, the profile is very prognathous, the great nose and extended lips forming sometimes almost an ape-like muzzle. The nose is large and not usually as flat as in some extreme forms of Negro, but much broader and flatter than in the preceding categories of Man. There is a slight tendency for the bridge of the nose to be arched, more so than in the Negro.

The brow-ridges are markedly projecting in both men and women, giving the face a lowering and savage aspect. The body is usually well shaped, but in the more northern types of the Australoid and in islands where it has mingled anciently with the Oceanic Negro, the big toe is rather more separated than the other toes of the foot. These other toes are longer and the whole aspect of the foot approximates slightly to that of an anthropoid ape, though this ape-like type of foot may recur in some specimens of the Negro sub-species, especially in the Oceanic Negroes, the Congo Pygmies and the Bushmen.

Ape-like Teeth

It is perhaps in his teeth that the Australoid betrays most clearly his archaic characteristics. The teeth are large and slightly more akin in shape and conformation to those of the anthropoid. The canine teeth occasionally project a little and are larger than those in other existing humans.

(5) *The Negro Sub-species.*—In some respects, as regards physique, the Negro at the present day is at one extreme of the range of human variation, while the European man is at the other. This does not necessarily mean that the Negro is always inferior to the White man in bodily or mental development. He is not an unsuccessful vanishing type like the Australoid or the Amerindian.

He is a type—whether we like him or not—with a great future ahead of him. To a considerable extent the future of the western half of the Old World has oscillated between White man and Negro. The Negro would seem to have originated in the Mediterranean basin or in Western Asia, from the Australoid or basic species of Man, whilst the White man was growing out of the same stock farther to the north-east and north-west. The early White men—we might permissibly imagine—invaded Europe under the form of the Cro Magnon variety (preceded and succeeded by the Mongoloid). They then absorbed the pre-existing dark-skinned Austra-

From a photo lent to Sir H. H. Johnston

TYPICAL BLACK AUSTRALIAN

belonging to the human species which comes nearest to primitive man. His teeth, which are large and akin in shape and conformation to those of the anthropoid, betray his archaic characteristics; the canine teeth project and are larger than those in other existing humans.

Photo: Sir H. H. Johnston.

TYPICAL NEGRO

from the borderland between the Congo State and Egyptian Sudan

loids, and drove the Negro southward and ever southward, first into North-west and Central Africa, then into Southern Asia and Oceania. At the present day there is still a great Negro belt round the Old World, extending from Senegal in the west of Africa to the Solomon Islands in the Pacific.*

The physical characteristics of the Negro are a long skull—together with the Australoid he is the most dolichokephalous of existing human varieties—a projecting muzzle and retreating chin, a flat nose with large nostrils, a rounded, bulging forehead (nearly always without marked brow-ridges), large eyes with brown irises and somewhat discoloured "whites," somewhat prominent cheekbones, a very dark skin colour, a most characteristic body odour, a straighter back from the less inward curvature of the spine over the loins, and black hair with a strong tendency to curl.

The hair in the most specialised forms of Negro grows in isolated patches on the head and body, with lanes of bare skin between the "peppercorns" of hair.

The Negro must be further subdivided into the True Negro and the Bushman.

Bushmen and Forest Negroes

The Bushman is allied to the Negro as regards his tightly curled hair, but he has a yellow skin, a small nose, a peculiarly shaped "folded-over" ear, a tendency to excessive accumulation of fat at the hinder end of the body, and peculiarities of the reproductive organs which are not ordinarily met with amongst Negroes. He is probably an ancient Negro type specialised for life in arid regions, a type that once inhabited Europe, the Mediterranean basin, and the greater part of Africa, and was absorbed by the after-coming black Negroes and White men, who mingled with the Bushman.

The true Negro may be further subdivided into the Forest Negro and the Nilotic Negro. The Forest Negro is characterised by his powerful torso, his generally very marked "negro" facial features (protruding and everted lips, sloping facial outline, big mouth and teeth and horseshoe palate), his short, stout legs, and very long arms. H. H. J.

* The Asiatic and Oceanic Negroes differ in some points—chiefly the more marked development of the brow-ridges and the absence of the very characteristic skin odour—from the African. But as a distinct Negro type they are present in the population of Southern India, the Andaman Islands, the Southern Malay peninsula, portions of Sumatra, the Philippine Islands, and most islands of the Malay archipelago except Borneo. The absence of all traces of negroid tribes in Borneo is very remarkable and difficult to explain.

Continued from page 157.

LANGUAGES:

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LATIN.—XII

VERBS OF 3RD CONJUGATION IN -ĭō

Căpĭō, 3, *I take; bases*, **căp-, cēp-, capt-**

ACTIVE VOICE

Chief Parts: **căpio, cēpī, captum, capĕrĕ**

Indicative Mood

PRESENT	IMPERFECT	FUTURE
Sing.	*Sing.*	*Sing.*
căp-**ĭō**	căp-**iēbam**	căp-**iam.**
căp-**is**	căp-**iēbās**	căp-**iēs.**
căp-**it**	căp-**iēbăt**	căp-**iĕt.**
Plur.	*Plur.*	*Plur.*
căp-**imŭs**	căp-**iēbāmŭs**	căp-**iēmŭs.**
căp-**itis**	căp-**iēbātis**	căp-**iētis.**
căp-**iunt**	căp-**iēbant**	căp-**ient.**

PERFECT	PLUPERFECT	FUTURE PERFECT
Sing.	*Sing.*	*Sing.*
cēp-**ī**	cēp-**ĕram**	cēp-**ĕrō.**
cēp-**istī**	cēp-**ĕrās**	cēp-**ĕris.**
cēp-**it**	cēp-**ĕrăt**	cēp-**ĕrit.**
Plur.	*Plur.*	*Plur.*
cēp-**imŭs**	cēp-**ĕrāmŭs**	cēp-**ĕrimŭs.**
cēp-**istis**	cēp-**ĕrātis**	cēp-**ĕritis.**
cēp-**ērunt** or **cēpērĕ**	cēp-**ĕrant**	cēp-**ĕrint.**

Subjunctive Mood

PRESENT	IMPERFECT
Sing.	*Sing.*
căp-**iam**	căp-**ĕrem.**
căp-**iās**	căp-**ĕrēs.**
căp-**iăt**	căp-**ĕrĕt.**
Plur.	*Plur.*
căp-**iāmŭs**	căp-**ĕrēmŭs.**
căp-**iātis**	căp-**ĕrētis.**
căp-**iant**	căp-**ĕrent.**

PERFECT	PLUPERFECT
Sing.	*Sing.*
cēp-**ĕrim**	cēp-**issem.**
cēp-**ĕrīs**	cēp-**issēs.**
cēp-**ĕrit**	cēp-**issĕt.**
Plur.	*Plur.*
cēp-**ĕrīmŭs**	cēp-**issēmŭs.**
cēp-**ĕritis**	cēp-**issētis.**
cēp-**ĕrint**	cēp-**issent.**

Imperative Mood

PRESENT	FUTURE
Sing.	*Sing.*
cap-**ĕ**, *take thou.*	căp-**itō**, *thou shalt take.*
	căp**itō**, *let him take.*
Plur.	*Plur.*
cap-**itĕ**, *take ye.*	căpĭ-**tōtĕ**, *ye shall take.*
	căp-**iuntō**, *let them take.*

Infinitive Mood

PRESENT	PERFECT	FUTURE
căp-**ĕrĕ**	cēp-**issĕ**	captūr-**ŭs** essĕ.

GERUND	SUPINE
N. Acc. cap-**iendum**, *taking.*	*Acc.* cap-**tum**, *to take.*
Gen. cap-**iendī**	*Abl.* cap-**tū**, *in taking* or *to be taken.*
Dat. cap-**iendō**	
Abl. cap-**iendō**	

Participles

PRESENT	FUTURE
căp-**iens -ientis**	capt-**urŭs, -ūră, -ūrum.**

PASSIVE VOICE

Indicative Mood

PRESENT	IMPERFECT	FUTURE
Sing.	*Sing.*	*Sing.*
căp-**iŏr**	căp-**iēbăr**	căp-**iăr.**
căp-**ĕris**	căp-**iēbāris** or căp-**iēbārĕ**	căp-**iēris** or căp-**iērĕ.**
căp-**itŭr**	căp-**iēbātŭr**	căp-**iētŭr.**
Plur.	*Plur.*	*Plur.*
căp-**imŭr**	căp-**iēbāmŭr**	căp-**iēmŭr.**
căp-**iminī**	căp-**iēbāminī**	căp-**iēminī.**
căp-**iuntŭr**	căp-**iēbantŭr**	căp-**ientŭr.**

PERFECT	PLUPERFECT
Sing.	*Sing.*
capt-**ŭs** sum, ĕs, ĕst.	capt-**ŭs** ĕram, ĕrās, ĕrăt.
capt-**ī** sŭmŭs, estĭs, sunt.	capt-**ī** ĕrāmŭs, ĕrātĭs, ĕrant.

FUTURE PERFECT

Sing.

capt-**ŭs** ĕrō, ĕrĭs, ĕrĭt.
capt-**ī** ĕrĭmŭs, ĕrĭtĭs, ĕrunt.

Subjunctive Mood

PRESENT		IMPERFECT	
Sing.	*Plur.*	*Sing.*	*Plur.*
căp-**iar**	căp-**iāmŭr**	căp-**ĕrĕr**	căp-**ĕrēmŭr**
căp-**iārĭs** or cap-**iārĕ**	căp-**iāmĭnī**	căp-**ĕrērĭs** or căp-**ĕrērĕ**	căp-**ĕrēmĭnī**
căp-**iātŭr**	căp-**iantŭr**	căp-**ĕrētŭr**	căp-**ĕrentŭr**

PERFECT	PLUPERFECT
Sing.	*Plur.*
capt-**ŭs** sĭm, sīs, sĭt.	capt-**ŭs** essem, essēs, esset.
capt-**I** sīmŭs, sītĭs, sint.	capt-**I** essēmus, essētĭs, essent.

Imperative Mood

PRESENT

Sing.	*Plur.*
căp-**ĕrĕ**, *be thou taken.*	căp-**imĭnĭ**, *be ye taken.*

FUTURE

Sing.	*Plur.*
căp-**ĭtŏr**, *thou shalt be taken.*	căp-**iuntŏr**, *let them be taken.*
căp-**ĭtŏr**, *let him be taken.*	

Infinitive Mood

PRESENT	PERFECT	FUTURE
căp-**I**	capt-**ŭs** essĕ	captum īrī.

Participles

PERFECT	GERUNDIVE
capt-**ŭs, -ă, -um**	căp-**iendus, -iendă, -iendum.**

The group of verbs conjugated like **căpĭō** comprise the following:—

cŭpĭō, cŭpīvī, cŭpītum, cŭpĕrĕ, *to desire.*
făcĭō, fēcī, factum, făcĕrĕ, *to make.*
iăcĭō, iēcī, iactum, iăcĕrĕ, *to throw.*
răpĭō, răpŭī, raptum, răpĕrĕ, *to seize, to take away.*

Together with the deponent verbs:—

grădĭŏr, gressŭs sum, grădī, *to walk.*
mŏrĭŏr, mortŭŭs sum, mŏrī, *to die.*
pătĭŏr, passŭs sum, pătī, *to supper.*

Orĭŏr, ortŭs sum, ŏrīrī, *to rise,* is conjugated like **căpĭŏr**, except in certain forms following the fourth conjugation. In the imperfect subjunctive both **ŏrĕrĕr** and **ŏrīrĕr** occur. **Orĭŏr** and **mŏrĭŏr** have future participles **ŏrĭtūrŭs, mŏrĭtūrŭs.**

Deponent Verbs

Deponent Verbs are passive in form but active (transitive or intransitive) in meaning. They are conjugated like the ordinary passive verb; but in addition to the regular passive forms the deponents have the two active participles (present in **-ans** and future in **-ūrŭs**), the gerund and the supine. They also have the gerundive, which is passive in meaning. In a few verbs the perfect participle has a passive or both passive and active meanings, as **hortātŭs,** *having exhorted,* **ădeptŭs**, *obtained* or *having obtained,* **vĕnĕrātŭs,** *worshipped* or *having worshipped.*

These anomalous forms point to the existence of active forms of deponent verbs in older Latin. Probably in an intermediate stage of their history the passive forms had a reflexive or semi-passive meaning, as exemplified in **glŏrĭŏr,** *I boast,* (*I boast myself*).

With the exception of the three already given that are conjugated like **căpĭō**, deponents follow the regular conjugations, taking in addition the active forms mentioned above. It will repay the student to conjugate for himself the following Deponent Verbs, noting that these verbs follow the regular conjugation indicated by the numeral given after each:—

cōnŏr, -ātŭs, cōnārī, 1, *to endeavour.*
mīrŏr, -ātŭs, mīrārī, 1, *to wonder.*
intŭĕŏr, -ĭtŭs, -tŭērī, 2, *to behold.*
pollĭcĕŏr, -ĭtŭs, -ērī, 2, *to promise.*
frŭŏr, frŭĭtŭs or fructŭs, frŭī, 3, *to enjoy.*
fungŏr, funct-ŭs, fungī, 3, *to perform.*
largĭŏr, -ĭtŭs, -īrī, 4, *to give liberally.*
mentĭŏr, -ĭtŭs, -īrī, 4, *to lie.*

Exercise 12

Translate into English:—

1. Hanc eram ipsam excusationem relicturus. 2. Naturam si sequeremur ducem nunquam aberrabimus. 3. Consul senatui reique publicae se non defuturum pollicetur. 4. Acta illa res est animo virili, consilio puerili. 5. Ingens eo die res, ac nescio an maxima illo bello gesta sit. 6. Bonus volo jam ex hoc die esse. 7. Undique loci natura Helvetii continentur, una ex parte flumine Rheno, altera ex parte monte Jura, tertia lacu Lemanno. 8. Vides eum multa perficere, nos multa conari. 9. Adulescentium animi, molles et aetate fluxi, haud difficulter capiebantur.

Translate into Latin:—

1. Sabinus, having exhorted his men, gave the eagerly desired signal (gave the signal to those eagerly desiring it). 2. He shares his honour with Scipio. 3. The hours in which we were kept waiting (were expecting) seemed long. 4. The king seemed to me to speak most wisely. 5. Many things were urging the Galli to this conclusion. 6. I consider those people wise who use old wine. 7. The gods had given you wealth and the art of enjoyment. 8. The eyes very frequently deceive. 9. They appear to me to have established this for two reasons. 10. Why should I say more?

Key to Exercise 9

1. We have often heard this from our elders. 2. The shouting of our soldiers threw terror into the enemy. 3. Although all things are to be dreaded, we fear nothing more than treachery. 4. Fear seized the whole army. 5. You go on with your business when the adjoining wall is on fire. 6. Every good man delights to succour the unfortunate. 7. To virgins and youths I sing songs not heard before. 8. Forces not to be despised for the number or the kind of men. 9. He who does not occasionally do nothing does not seem to me to be free. 10. The senate and the people of Rome give one and the same opinion.

1. Africanus dicebat se nunquam plus agere quam nihil quum ageret. 2. Montes altissimi urbi impendent. 3. Nunquam ante hoc tempus populus consulem in iudicium vocavit. 4. Non solum terram habemus sed etiam magnum numerum servorum.

5. Multa mihi dixit, et pecuniam rogavit. 6. Quis scripsit has literas? 7. Vos, quoniam jam nox est in vestra tecta discedite. 8. Verres omnes libros, quos frater ejus reliquerat, mihi donavit. 9. Sunt multi qui eripiunt aliis quod aliis donant. 10. Caesar dicitur duo milia hominum in castris ante oppidum habuisse.

Key to Exercise 10

1. Deiotarus sent ambassadors to me (stating) that he was coming with all his forces. 2. The question was debated in the general assembly whether Avaricus should be burned or defended. 3. The consul asked my opinion first. 4. What are you doing? I am reading Caesar's book concerning the Gallic war. 5. He who despises himself has in him the desire of virtue. 6. It should be said more often. 7. We are said to be the two happiest of all. 8. Such fear had seized the entire army. 9. One way alone remained, across the land of the enemy.

1. Dum haec Romae geruntur, Caesar legatos in Britanniam misit. 2. Dux praedam militibus donavit qui urbem expugnaverant. 3. Non multa postea Romani in terra eorum castra posuerunt. 4. Vident et sentiunt idem quod vos. 5. Mihi vir prudens videbaris. 6. Suus cuique locus erat definitus. 7. Altera pars Italiae montibus et altera mari munita est. 8. Bella fortius quam felicius geris. 9. Caesar legatos statim remisit.

Key to Exercise 11

1. Not only do I consider that you arouse irritation, but you appear to me to be incensed yourself. 2. Since they had written many things concerning the public weal. 3. He writes to Labienus that he should come with a legion to the frontiers of the Nervii. 4. If by chance anything like this should ever occur. 5. You say he is the same person that you deny him to be. 6. I never was less satisfied with myself than yesterday. 7. He draws water defiled with mud. 8. From all other sides, hills surround the town. 9. Throughout the ages only three or four pairs of friends have become celebrated. 10. When my house was on fire with brands that had been flung into it.

1. Fortunatus sibi Damocles videbatur. 2. Dixit melius quam scripsit Hortensius. 3. De puteo aquam hauriebat. 4. Se in medios hostes iniecit. 5. Magis te amo quam oculos meos. 6. Caecina milites temporis ac necessitatis monuit. 7. Aedui, quum se suaque ab iis defendere non possent. 8. Filium suum ad virum quendam misit. 9. Septem fuisse dicuntur uno tempore qui sapientes haberentur. 10. Spem mihi omnem eripis.

E. A. B.

FRENCH.—XII

The Four Regular Conjugations.—In this lesson the first two conjugations are given in full.

I.—CHANTER, *to sing.*

chanter, chantant, chanté, je chante, je chantai

Indicative Mood

PRESENT	PAST INDEFINITE
je chante, *I sing*	j'ai chanté, *I have sung*
tu chantes	tu as chanté
il chante	il a chanté
nous chantons	nous avons chanté
vous chantez	vous avez chanté
ils chantent	ils ont chanté

IMPERFECT	PLUPERFECT
je chantais, *I was singing*	j'avais chanté, *I had sung*
tu chantais	tu avais chanté
il chantait	il avait chanté
nous chantions	nous avions chanté
vous chantiez	vous aviez chanté
ils chantaient	ils avaient chanté

PAST DEFINITE	PAST ANTERIOR
je chantai, *I sang*	j'eus chanté, *I had sung*
tu chantas	tu eus chanté
il chanta	il eut chanté
nous chantâmes	nous eûmes chanté
vous chantâtes	vous eûtes chanté
ils chantèrent	ils eurent chanté

FUTURE	FUTURE ANTERIOR
je chanterai, *I shall sing*	j'aurai chanté, *I shall have sung*
tu chanteras	tu auras chanté
il chantera	il aura chanté
nous chanterons	nous aurons chanté
vous chanterez	vous aurez chanté
ils chanteront	ils auront chanté

Conditional Mood

PRESENT	PAST
je chanterais, *I should sing*	j'aurais chanté, *I should have sung*
tu chanterais	tu aurais chanté
il chanterait	il aurait chanté
nous chanterions	nous aurions chanté
vous chanteriez	vous auriez chanté
ils chanteraient	ils auraient chanté

Imperative Mood

chante, *sing* (thou)
qu'il chante, *let him sing*
chantons, *let us sing*
chantez, *sing* (ye)
qu'ils chantent, *let them sing*

Subjunctive Mood

PRESENT	PERFECT
que je chante, *that I may sing*	que j'aie chanté, *that I may have sung*
que tu chantes	que tu aies chanté
qu'il chante	qu'il ait chanté
que nous chantions	que nous ayons chanté
que vous chantiez	que vous ayez chanté
qu'ils chantent	qu'ils aient chanté

IMPERFECT	PLUPERFECT
que je chantasse, *that I might sing*	que j'eusse chanté, *that I might have sung*
que tu chantasses	que tu eusses chanté
qu'il chantât	qu'il eut chanté
que nous chantassions	que nous eussions chanté
que vous chantassiez	que vous eussiez chanté
qu'ils chantassent	qu'ils eussent chanté

Infinitive Mood

PRESENT	PAST INDEFINITE
chanter, *to sing*	avoir chanté, *to have sung*
PRESENT PARTICIPLE	**PAST PARTICIPLE**
chantant, *singing*	chanté, chantée, *sung*

II.—FINIR, *to finish.*

finir, finissant, fini, je finis, je finis

Indicative Mood

PRESENT	PAST INDEFINITE
je finis, *I finish*	j'ai fini, *I have finished*
tu finis	tu as fini
il finit	il a fini
nous finissons	nous avons fini
vous finissez	vous avez fini
ils finissent	ils ont fini
IMPERFECT	PLUPERFECT
je finissais, *I was finishing*	j'avais fini, *I had finished*
tu finissais	tu avais fini
il finissait	il avait fini
nous finissions	nous avions fini
vous finissiez	vous aviez fini
ils finissaient	ils avaient fini
PAST DEFINITE	PAST ANTERIOR
je finis, *I finished*	j'eus fini, *I had finished*
tu finis	tu eus fini
il finit	il eut fini
nous finîmes	nous eûmes fini
vous finîtes	vous eûtes fini
ils finirent	ils eurent fini

Conditional Mood

PRESENT	PAST
je finirais, *I should finish*	j'aurais fini, *I should have finished*
tu finirais	tu aurais fini
il finirait	il aurait fini
nous finirions	nous aurions fini
vous finiriez	vous auriez fini
ils finiraient	ils auraient fini

Imperative Mood

finis, *finish* (thou)
qu'il finisse, *let him finish*
finissons, *let us finish*
finissez, *finish* (ye)
qu'ils finissent, *let them finish*

Subjunctive Mood

PRESENT	PERFECT
que je finisse, *that I may finish*	que j'aie fini, *that I may have finished*
que tu finisses	que tu aies fini
qu'il finisse	qu'il ait fini
que nous finissions	que nous ayons fini
que vous finissiez	que vous ayez fini
qu'ils finissent	qu'ils aient fini
IMPERFECT	PLUPERFECT
que je finisse, *that I might finish*	que j'eusse fini, *that I might have finished*
que tu finisses	que tu eusses fini
qu'il finît	qu'il eût fini
que nous finissions	que nous eussions fini
que vous finissiez	que vous eussiez fini
qu'ils finissent	qu'ils eussent fini

Infinitive Mood

PRESENT	PAST INDEFINITE
finir, *to finish*	avoir fini, *to have finished*
PRESENT PARTICIPLE	PAST PARTICIPLE
finissant, *finishing*	fini, finie, *finished*

VOCABULARY

aimer, *to love.*
l'amour (m.), *love.*
l'appartement (m.), *a room or set of rooms.*
arriver, *to arrive.*
aujourd'hui, *to-day.*
baisser, *to lower.*
bientôt, *soon.*
le bœuf, *beef.*
la chanson, *the song.*
chercher, *to seek.*
chérir, *to cherish.*
décider, *to decide.*
de côté, *sideways.*
découvrir, *to find.*
demeurer, *to reside.*
descender, *to descend, get down.*
Didon, *Dido.*
douter, *to doubt.*
la drôlesse, *the hussy.*
emporter, *to carry off.*
entrer, *to enter.*
fournir, *to furnish.*
l'hiver (m.), *winter.*
laisser, *to let, let go.*
la leçon, *the lesson.*
la lecture, *reading.*
libre, *free.*
la maîtresse, *the mistress, the sweetheart.*
les marchandises (f.), *goods.*
le mouton, *mutton.*
obliger, *to oblige.*
oser, *to dare.*
la paille, *straw.*
Parisien, -enne, *Parisian.*
parler, *to speak.*
le pas, *the step, pace.*
le pavé, *the pavement, the road.*
la pensée, *thought.*
le piège, *the snare.*
la porte, *the door.*
porter, *to carry, to wear.*
raconter, *to relate.*
reculer, *to draw back, retire.*
regarder, *to look at.*
rougir, *to redden, blush.*
sentir, *to feel.*
le soupçon, *the suspicion*
sur, *on, upon.*
sourir, *to smile.*
le talon, *the heel.*
la tête, *the head.*
traverser, *to cross.*
trouver, *to find.*

Exercise 21

1. Jules en arriva à décider que la dame était Parisienne. 2. Il découvrait dans la femme aimée une beauté nouvelle. 3. De nouvelles pensées entraient dans l'âme du poëte. 4. Il ouvrit la porte. 5. Il rougit un peu, lui prit la main, et la fit entrer. 6. Il recula de deux pas pour mieux la voir. 7. J'aimerais mieux que ce fût une drôlesse. 8. J'ai bien peur que ce soit une vieille femme. 9. Hélène sourit et ne parla plus. 10. Il avait raconté à sa maîtresse les amours de Calypso et de Didon. 11. Je ne l'ai pas regardé, monsieur. 12. Ils la regardèrent de côté en baissant la tête. 13. Elle traversa la place de la Concorde. 14. Elle entra dans la rue de Richelieu. 15. Il fut obligé de descendre sur le pavé. 16. Demeure-t-elle à Montmartre? 17. On eût dit qu'elle sentait Jules sur ses talons. 18. Il n'osait entrer dans le magasin. 19. Il eut le soupçon d'un piège. 20. On était encore en hiver.

Exercise 22

1. Will you (wilt thou) have finished soon? 2. Is it really true? said Hélène. 3. Oh! don't doubt me. 4. Let me speak, then. 5. I was looking for rooms (an apartment) for my brother. 6. She leaves you free. 7. She did not leave him time to speak. 8. Do you sing an Italian song? 9. We sing an English song. 10. Are you taking this book to the man? 11. No, I am taking it to my brother. 12. Do you take away all your money? 13. I take away only a part of it. 14. Do you finish your lesson to-day? 15. We finish it this morning. 16. Do you not like attentive children? 17. I like them much. 18. Does your mother like reading? 19. Yes, miss, she likes it much more than her sister

does. 20. What hat does your cousin wear? 21. He wears a silk hat, and I wear a straw hat.

Key to Exercise 17

1. Where are we, then, postilion? 2. He was pale, not like a dead man, but like death itself. 3. I do not know what she has for you, but I know what she has for me. 4. You do me far too much honour. 5. One would say it is still the same curtain. 6. I was, it is true, second lieutenant at that date. 7. I was very sure of it. 8. The fortress of Liége is taken. 9. It was a young lady. 10. I was, then, eighteen. 11. I have seen plenty of romances begin there. 12. He was older than I. 13. I have told you, nothing mattered to me. 14. One lives more in the life one has not than in the life that one has. 15. Do you want your servant? 16. Does your father want you and your sisters? 17. He has not much money; he has enough. 18. Does he want his books badly? 19. He wants them badly. 20. Have you not said anything to my cousin?

Key to Exercise 18

1. Votre belle-mère a-t-elle quelque chose à faire? 2. Elle n'a rien à faire. 3. A-t-elle deux pages à écrire? 4. Non, monsieur, elle n'en a qu'une. 5. Avez-vous l'intention de lire ce journal? 6. Oui, madame, j'ai l'intention de le lire. 7. Avez-vous raison d'acheter un habit de velours? 8. J'ai raison d'en acheter un. 9. Votre petite fille a-t-elle besoin de dormir? 10. Oui, monsieur, elle a besoin de dormir, elle est fatiguée. 11. Avez-vous peur de tomber? 12. Je n'ai pas peur de tomber. 13. Le jardinier a-t-il le temps de travailler dans les champs? 14. Il n'a pas envie de travailler dans les champs. 15. Vos champs sont-ils aussi grands que les miens? 16. Ils sont plus grands que les vôtres. 17. Avez-vous envie de marcher? 18. Je n'ai pas envie de marcher, mais j'ai envie de danser. 19. Quel âge a votre fils? 20. Il a seize ans.

Key to Exercise 19

1. They have a big house and a fine garden. 2. He would have a fine situation. 3. I shall be too pleased to do it. 4. Have a little patience—wait. 5. Have you any money? 6. I have not enough. 7. She was this ever since that first night. 8. I am pleased to have met you. 9. Well, no, it was not that. 10. I took my courage in both hands. 11. We were the real friends of that unfortunate young man. 12. Was he worthy to be the husband of such a great lady? 13. She had none of these vulgar misgivings. 14. And if it was so by day, it was also the same a great part of the night. 15. Such were the wretched occupations to which she had condemned me. 16. Was it only a caprice? 17. Have more courage. 18. Would that I had a good deal more money. 19. We should have had a fine journey. 20. Be obedient to your parents.

Key to Exercise 20

1. Je suis bien malheureux. 2. Tu es un grand poëte. 3. Il est marchand de vins. 4. Nous sommes très pauvres. 5. Êtes-vous contents? 6. Ils sont contents de le voir. 7. J'ai honte de le dire. 8. Tu as raison. 9. Il n'en a pas le courage. 10. Nous avons envie de marcher. 11. Vous avez tort. 12. Vous avez une belle maison. 13. Ils ont eu bien des chagrins. 14. J'eus une grande bibliothèque. 15. Nous eûmes un grand champ et un beau jardin. 16. Nous aurions honte de faire cela. 17. Le vent sera favorable. 18. Ce serait un beau tableau. 19. Ce serait la première fois.

E. A. B.

GERMAN.—IX

Notes on the Passive Voice.—German transitive verbs have a kind of Future Passive Participle formed by the prep. zu and the Pres. Part. of the verb. Thus, ein zu liebendes Kind, *a child to be loved.*

Practically all trans. verbs, with the exception of haben, have a Passive Voice.

Many intrans. verbs may form a sort of impersonal passive. They have as subject the pron. es. Thus, es wurde getanzt, *there was dancing.*

On the whole the Passive is much less used in German than in English; the indef. pron. man, *one* (French *on*), is used with an active verb in very many cases. In others a reflexive verb is used. Thus, man sagt, *it is said.* Ein Mittel hat sich gefunden, *a means has been found.*

Owing to the use of werden to form the Passive and the use of sein with a Past Part. used adjectivally, we can in German distinguish clearly between the description of an action and the description of a state. Thus, Sie wurden gefangen, *they were caught;* this describes the action of their being caught. But sie waren gefangen, *they were in a state of having been caught,* i.e. *they had been caught;* this describes a state.

The Use of haben and sein as Auxiliaries.—Verbs which take haben as an auxiliary to form their Perf. tenses:

1. All trans. verbs, including the Modal Auxiliaries and reflex. verbs.
2. Most intrans. verbs which govern a noun in the gen. or dat. case.
3. Many other intrans. verbs, including all proper impersonal verbs.

Verbs which take sein as an auxiliary to form their Perf. tenses:

1. Many intrans. verbs, especially such as denote a change of condition, or a movement of translation from one point to another.
2. A few others which govern a noun in the dat. case; namely, begegnen, *to meet,* folgen, *to follow,* weichen, *to give way,* gelingen and glücken, *to turn out well* or *successfully,* and their opposites, mißlingen, mißglücken; bleiben, *to remain.*

It is useless for the student to attempt to learn lists of verbs which are conjugated with haben and sein respectively. The above are only given for his general guidance; he should, when reading German, take careful note of such verbs as are conjugated with sein, and try to remember them.

Numerals may be classified as Cardinal and Ordinal.

Cardinal Numbers

eins, *one.*	achtzehn, *eighteen.*
zwei, *two.*	neunzehn, *nineteen.*
drei, *three.*	zwanzig, *twenty.*
vier *four.*	ein und zwanzig, *twenty-one.*
fünf, *five.*	zwei und zwanzig, *twenty-two.*
ſechs, *six.*	dreißig, *thirty.*
ſieben, *seven.*	ein und dreißig, *thirty-one.*
acht, *eight.*	vierzig, *forty.*
neun, *nine.*	fünfzig, *fifty.*
zehn, *ten.*	ſechzig, *sixty.*
elf *eleven.*	ſiebzig, *seventy.*
zwölf, *twelve.*	achtzig, *eighty.*
dreizehn, *thirteen.*	neunzig, *ninety.*
vierzehn, *fourteen.*	hundert, *hundred.*
fünfzehn, *fifteen.*	tauſend, *thousand.*
ſechzehn, *sixteen.*	
ſiebzehn, *seventeen*	

101, hundert (und) eins.
193, hundert drei und neunzig.
200, zweihundert.
367, drei hundert ſieben und ſechzig.
5000, fünftauſend.
6003, ſechs tauſend und drei.
100,000, hundert tauſend.
1,000,000, eine Million (mil'lyohn).
2,000,000, zwei Millionen.

The only one of these that is declined is eins, which, as ein, eine, ein, is used as the indef. art. Hundert and Tauſend, when used as nouns without numerals before them, form their plural like strong nouns of class 2. Thus, Hunderte von Menſchen waren dort, *hundreds of people were there;* er kam mit Tauſenden, *he came with thousands.* Million is a weak feminine noun. Hundert and Tauſend do not have ein prefixed to them.

Ordinal Numbers from 2 to 19 are formed from the Cardinals by adding the suffix **t**; from 20 upwards they are formed by adding the suffix **ſt**. They are declined like ordinary adjectives. Erſt, *first*, is really the superlative of ehe, *before*, comparative eher, *sooner*. Dritt, *third*, shortens the stem vowel ei to i.

Ordinal Numbers

der, die, das, erſte,	*the first.*
der, die, das, zweite,	*the second.*
der, die, das dritte,	*the third.*
der, die, das vierte,	*the fourth.*
der, die, das fünfte,	*the fifth.*
der, die, das ſechſte,	*the sixth.*
der, die, das ſiebente,	*the seventh.*
der, die, das achte,	*the eighth.*
der, die, das neunte,	*the ninth.*
der, die, das zehnte,	*the tenth.*
der, die, das elfte,	*the eleventh.*
der, die, das zwölfte,	*the twelfth.*
der, die, das dreizehnte,	*the thirteenth.*
der, die, das vierzehnte,	*the fourteenth.*
der, die, das fünfzehnte,	*the fifteenth.*
der, die, das ſechzehnte,	*the sixteenth.*
der, die, das ſiebzehnte,	*the seventeenth.*
der, die, das, achtzehnte,	*the eighteenth.*
der, die, das neunzehnte,	*the nineteenth.*
der, die, das zwanzigſte,	*the twentieth.*
der, die, das ein und zwanzigſte,	*the twenty-first.*
der, die, das neun und achtzigſte,	*the eighty-ninth.*
der, die, das hundertſte,	*the hundredth.*
der, die, das zweihundertſte,	*the two hundredth.*
der, die, das drei hundert, ſieben und ſechzigſte,	*the three hundred and sixty-seventh.*
der, die, das tauſendſte,	*the thousandth.*
der, die, das hunderttauſendſte,	*the hundred thousandth.*
der, die das, letzte,	*the last.*

Compound Ordinal Numbers add the ordinal ending to the last member only, as in English. This is exemplified by some of the numerals given above. Other numerals are derived from the Cardinals and Ordinals.

From the Cardinals we have the following:

MULTIPLICATIVES.—These are formed by adding the termination fältig or fach to the cardinals. Einfach or einfältig, *simple* (literally onefold); zweifach or zweifältig, *double* or *twofold;* dreifach or dreifältig, *treble* or *threefold;* zehnfach or zehnfältig, *tenfold*, and so on.

ITERATIVES.—These are formed by adding the termination mal. Einmal, *once;* zweimal, *twice;* dreimal, *thrice* or *three times;* zehnmal, *ten times*, and so on.

VARIATIVES.—These are formed by adding the termination erlei. They do not exist as single words in English. Einerlei, *of one kind*, zweierlei, *of two kinds*, vielerlei, *of many kinds.*

Of the above the first are adjectives and are treated in every way like ordinary adjectives. The second are adverbs. The third are adjectives but are incapable of declension.

From the Ordinals we have the following:

FRACTIONALS.—These are formed by the addition of the termination **tel**, before which the t of the ordinal termination drops. Drittel, *third;* viertel, *quarter* or *fourth;* zehntel, *tenth part.* This termination tel is really a contraction of the word Teil *part. Half* is halb when used as an adjective, and Hälfte, w.f., when used as a noun.

Ordinal Adverbs add the termination **ens**: Erſtens, *firstly;* zweitens, *secondly;* fünftens, *fifthly*, etc.

Another class of numerals is formed by adding the word halb to the Ordinal. These denote a quantity less by half a unit than the cardinal corresponding to the ordinal. Thus viertehalb means *four less a half*, i.e. three and a half. These are invariable adjectives. *One and a half* is not zweithalb as one would expect, but anderthalb, which is formed from ander, *other.*

Times and Dates.—It should be noted that in telling the time the German differs from the English in the following ways: The half-hours are reckoned as half-way on to the next hour. The quarters are reckoned either as in English or on towards the next hour. The following will illustrate this:

10. 0—zehn Uhr.
10. 5—fünf Minuten nach zehn.
10.15—(ein) Viertel nach zehn or (ein) Viertel (auf) elf, i.e. *a quarter towards eleven.*
10.25—fünf und zwanzig Minuten nach zehn.
10.30—halb elf, i.e. *half eleven.*
10.35—fünf und zwanzig Minuten vor elf.
10.45—(ein) Viertel vor elf or drei Viertel (auf) elf.
11. 0—elf Uhr.

In the above the words in brackets may be omitted.

A.M., Vormittags. *P.M.*, Nachmittags.

In expressing dates the day of the month is either put in the acc. or else am (an dem, *on the*) is prefixed.

On the fifteenth of January is am fünfzehnten Januar.

Thursday, the thirteenth of March, is Donnerstag den dreizehnten März.

Years are expressed as follows:

Im Jahre 1905 or in 1905.

Thursday, March 13th, 1905, is Donnerstag den 13. März 1905.

Wie viel Uhr iſt es? / Was iſt die Uhr? } *What is the time?*
Es iſt ein Uhr. *It is one o'clock.*
Um wie viel Uhr kommt er? *At what time does he come?* (literally *at how much time*).
Er kommt um drei Uhr. *He comes at three o'clock.*
Der wievielte iſt heute? *What date is it to-day?* (literally *the how manyeth is to-day*).
Es iſt der achte Februar. *It is the 8th of February.*
Den wievielten haben wir heute? *What date is it* (have we) *to-day?*
Wir haben heute den zwanzigſten. *It is the 20th.*

VOCABULARY

vergehen, s., *to pass away, perish.*
machen, w., *to make.*
Fahrkarte, w.f., *ticket.*
laſſen, s.2c, *to let, allow.*
ein'ſchreiben, s.3b, *register.*
bezahlen, w., *to pay.*
erledigen, w., *to accomplish.*
Zug, s.m.2, *train.*
warten, w., *to wait.*
Verſpätung, w.f., *lateness, delay.*
ziemlich, *fairly.*
an'kommen, s., *to arrive.*
nachdem, *after* (conj.).
Tee, s.m., *tea.*
holländiſch, *Dutch.*
nehmen, s.1c, *take.*
legen, w., *to lay.*
ſchlafen, s.2c, *to sleep.*
Automobil, s.n.2, *motor-car.*
Klaſſe, w.f., *class.*
Koffer, s.m.1, *trunk.*
Überfracht, w.f., *overweight.*
ſteigen, s.3b, *to climb, mount.*
Bahnſteig, s.m.2, *platform.*
nur, *only.*
alſo, *consequently, therefore.*
pünktlich, *punctually.*
an Bord, *on board.*
Taſſe, w.f., *cup.*
einige, *some.*
Zwieback, s.m.2, *rusk.*
zu ſich nehmen, *to take to oneself*, i.e. *to eat.*
ſich ſchlafen legen, *to lay oneself to sleep*, i.e. *to go to bed.*
an'weiſen, s.3b, *to assign.*
Kajüte, w.f., *cabin.*
früh, *early.*
Uhr, w.f., *clock, o'clock.*
Zollbeamte, w.m., Custom *House officer.*
Handgepäck, *hand-luggage, small luggage.*
ſogenannt, *so-called.*
Speiſewagen, s.m.1, *restaurant car.*
Kaffee, s.m., *coffee.*
geben, s.2a, *to give.*
Mittageſſen, s.n.1, *midday meal*, i.e. dinner.
Eiſenbahn, w.f., *railway.*
denn, *for* (conj.).
norddeutſch, *north German.*
im Ganzen, *on the whole.*
unintereſſant, *uninteresting.*
Zollreviſion, w.f., *Customs examination.*
Herbſt, s.m.,2, *autumn.*
Morgen, s.m. 1, *morning.*
um, at (referring to time).
Vließingen, *Flushing.*
durchlaſſen, *to let through.*
ohne, *without* (gov. acc.).
unterſuchen, w., *to examine.*
Berliner (bayrleener), *Berlin* (adj.).
Schnellzug, s.m.2, *express train.*
Frühſtück, s.m.2, *breakfast.*
Brötchen, s.n.1, *roll.*
ſpät, *late.*
ein'nehmen, s.1c, *to take in*, i.e. *to eat.*
langweilig, *slow, boring.*
Gegend, w.f., *neighbourhood, landscape.*
Ebene, w.f., *plain.*
flach, *flat.*
Grenze, w.f., *boundary.*
aus'ſteigen, s.3b, *to get out.*
man, *one* (indef. pron.).

Exercise 25

Eine Reiſe nach Deutſchland.

Ich habe vergangenen[1] Herbſt eine Reiſe nach Deutſchland gemacht. Ich fuhr mit meinem Gepäck in einem Automobil nach dem Bahnhof, kaufte dort eine Fahrkarte erſter Klaſſe[2] und ließ[3] meine Koffer nach der Friedrichſtraße einſchreiben[4]. Ich mußte 10 Mark Überfracht bezahlen. Endlich war das Einſchreiben erledigt, und ich ſtieg in den Zug der am Bahnſteig wartete. Der Zug hatte nur wenig Verſpätung, ich kam alſo ziemlich pünktlich in Folkeſtone an wo ich an Bord ging; nachdem ich eine Taſſe[4] Tee und einige holländiſche[7] Zwiebäcke zu mir genommen hatte, legte ich mich ſchlafen in der mir angewieſenen Kajüte.[5] Morgens[6] früh um 4 Uhr kamen wir in Vließingen an; die Zollbeamten ließen mich durch ohne mein Handgepäck zu unterſuchen, und ich ſtieg in den Berliner[7] Zug. Dies[8] war ein ſogenannter D-Zug, ein Schnellzug mit einem Speiſewagen, wo ich mir zum erſten Frühſtück Kaffee und Brötchen geben ließ, und wo ich auch ſpäter das zweite Frühſtück und das Mittageſſen einnahm. Die Eiſenbahnreiſe war ziemlich langweilig denn die Gegend in Holland und in der norddeutſchen Ebene, die wir durchfuhren, iſt im Ganzen flach und unintereſſant. An der deutſchen Grenze mußte ich für die Zollreviſion ausſteigen, denn man unterſuchte dort nicht nur das Handgepäck ſondern auch die großen Koffer.

NOTES:

(1) vergangenen, the past part., is used as an adj. and means *last.* (2) erſter Klaſſe gen., i.e. a ticket of first class. (3) ließ—this is an idiomatic use of laſſen, followed by an infinitive, and is equivalent to the English "to have a thing done." (4) Taſſe Tee, literally a cup tea, Tee being in apposition to Taſſe. (5) Kajüte, the construction is typically German, the to me assigned cabin. (6) Morgens, the gen. of nouns referring to time is often used adverbially. (7) Berliner, adjectives formed from the names of towns by addition of er are not declined, and are written with a capital; adjectives formed from the names of countries are declined, and are not written with a capital. (8) Dies, the nom. and acc. sing. neut. of dieſes, is frequently contracted to dies, especially when the word is used as a demons. pron. (9) ließ, *see* (3).

Fredrichſtraße (Frederick Street) is the name of one of the large railway stations in Berlin.

The student will observe that all verbs compounded with separable prefixes have an accent on the prefix in the Vocabulary; it has therefore seemed unnecessary to call his attention to them in these Notes.

Exercise 26

(1) He has been in Germany three times; once he went with his father and twice with his sister. (2) Many thousand people travel to Germany; many of them go from Folkestone to Flushing and from there to the large towns in the North German plain. (3) He does not like train travelling, but is much happier on board a ship. (4) When he arrived at the station he had their luggage registered to Berlin. (5) The Berlin coffee and rolls that one has for breakfast are very good. (6) I went to Germany for the first time last year. (7) The Custom House officers will not let you through without examining your trunks and your small luggage.

Key to Exercise 23

THE FOX AND THE GEESE

A fox once came on to a meadow where a flock of fine fat geese was sitting; then he laughed and said, "I come very opportunely (I come as though called); in this way I can eat up one after the other (you are sitting all together so nicely, so I can eat up one after the other)." The geese cackled with terror, jumped up, began to lament and beg pitifully for their lives. But the fox would listen to nothing and said, "No mercy will be shown (there is no mercy); you must die." At last one took heart and said, "If, after all, we poor geese must lose our lives, show us this one mercy and allow us one more (still one) prayer, so that we may not die in sin (in our sins); after that we will indeed place ourselves in a row, so that you can always pick out the fattest." "Yes," said the fox, "that is fair, and is a pious request; pray—I will wait meanwhile (so long)." So the first began a very long prayer, always "ga, ga," and as it would not leave off at all, the second did not wait till her turn came (the turn came to her), but also began "ga, ga." The third and fourth followed suit (followed her), and soon they were all cackling together. (And when they have finished praying the story shall be continued, but meanwhile they are still going on praying.)

Key to Exercise 24

Wir kamen gestern auf eine Wiese wo wir zwei Füchse und eine Herde schöner fetter Gänse sahen. Die Füchse wollten die Gänse, die in einer Reihe saßen, auffressen. Aber sie sprangen auf, eine nach der andern, und gackerten so daß die Füchse vor Schrecken wegliefen. Ich konnte nicht hören was mein Freund sagte als die Gänse zu gackern anfingen. Ich wollte Sie hätten mit uns kommen dürfen, Sie würden gelacht haben. Wir warteten bis es spät war, dann mußten wir gehen. Sie müßen bald kommen uns zu sehen.

(2) Schöner fetter Gänse, gen. depending on Herde; der andern, dat. gov. by prep. nach; Leben, acc. gov. by prep. um; Herz, acc. gov. by trans. verb nehmen; unsern Sünden, dat. gov. by prep. in (rest). eine Reihe, acc. gov. by prep. in (motion). (3) da lachte er, inverted order as the sentence begins with the word da; so kann ich, inverted order as the sentence begins with the word so; damit wir . . . . . sterben, finite verb at the end, as it is a dependent clause; wartete die zweite, inverted order, as the principal clause is preceded by a dependent clause weil . . . . wollte; die Reihe . . . . . kam, finite verb at the end in a dependent clause.

M. A. L.

RUSSIAN.—II

The Noun

1. NOUNS have three genders, known by their endings, viz.:

(*a*) Masculine—ending in:

	ъ	й	ь
Example:	Фабрика́нтъ	Казначе́й	Покупа́тель
Pron.:	fa-bri-kánt	kaz-na-chéi	pa-ku-pá-tyel
	manufacturer	*treasurer*	*client, customer, buyer.*
Example:	Това́ръ	Сара́й	Ве́ксель
Pron.:	ta-vár	sa-ràĭ	vyék-sel′
	goods	*stable*	*bill.*

The ending -ь is in most cases feminine.

(*b*) Feminine—ending in:

	а	я	ь
Example:	Госпожа́	Госуда́рыня	Мать
Pron.:	gas-pa-zhá	ga-su-dá-rü-nya	mat′
	Mrs.	*madam, queen.*	*mother.*
Example:	Фи́рма	Торго́вля	При́быль
Pron.:	fír-ma	tar-góv-lya	pri-′bwül
	firm.	*trade, business.*	*gain, profit.*

(*c*) Neuter—ending in:

	о	е
Example:	Сло́во	По́ле
Pron.:	sló-vo	pó-lye
	word.	*field.*

2. The accusative (or direct object) changes the nominative endings **ъ**, **й**, **ь**, in masculine nouns denoting living beings, into **а**, **я**, **я**, respectively. The accusative of the nominatives фабрика́нтъ, казначе́й, покупа́тель, is therefore фабрика́нта, казначе́я, покупа́теля, respectively.

3. Masculine names of inanimate things and all nouns with a neuter ending are the same in the accusative as in the nominative. Thus, the nouns това́ръ, сара́й, ве́ксель, сло́во, and по́ле are alike in the nominative and accusative.

4. All feminine words end in the accusative in **у**, **ю**, and **ь**, respectively. The feminines will become in the accusative: госпожу́, фи́рму, госуда́рыню, торго́влю, мать, and при́быль.

Practice I

Find the accusative of the following:

Англича́нинъ	(an-gli-chá-nin),	*Englishman.*
Кліе́нтъ	(kli-yént),	*client.*
Столъ	(stol),	*table.*
Магази́нъ	(ma-ga-zin),	*warehouse.*
Геро́й	(ge-rói *),	*hero.*
Лѣнтя́й	(lyen-tyái),	*idler.*
Бой	(boi),	*fight.*
Засто́й	(za-stói),	*stagnation.*
Посѣти́тель	(pa-sye-tí-tyel′),	*visitor.*
Апте́карь	(ap-tyé-kar′),	*apothecary.*
Ни́ккель	(ník-kel′),	*nickel.*

* *g* always hard.

Автомоби́ль	(af-ta-ma-bil'),	*automobile.*
Англича́нка	(an-gli-chán-ka),	*English woman.*
Бума́га	(bu-má-ga),	*paper.*
Княги́ня	(knya-gí-nya),	*grand duchess.*
А́нглія	(án-gli-ya),	*England.*
Дочь	(doch'),	*daughter.*
Сукно́	(suk-nó),	*cloth.*
Желе́	(zhe-lé),	*jelly.*

Practice II

Find the nominative of the following, which are given in the accusative :

Францу́за	(fran-tsú-za),	*the Frenchman.*
Домъ	(dom),	*the house.*
Ге́нія	(gé-ni-ya *),	*the genius.*
Пай	(pai),	*the share.*
Царя́	(tsa-ryá),	*the Czar.*
День	(dyen'),	*the day.*
Сестру	(syes-trú),	*the sister.*
Кни́гу	(kní-gu),	*the book.*
Россію	(ras-sí-yu),	*Russia.*
Фра́нцію	(frán-tsi-yu),	*France.*
Ночь	(noch'),	*the night.*
Желѣзо	(zhe-lyé-zo),	*iron.*
Го́ре	(gó-re),	*trouble.*

* *g* always hard.

5. There is no article in Russian, and in translating the student adds **a** or **the**, according to requirements.

The Verb

First or "e" Conjugation

6. Present tense of regular verbs in **ать**, **ять**, and **ѣть** is formed by taking off **ть** from the Infinitive and replacing it by :

Sing.		*Plur.*	
1.	-ю	1.	-емъ
2.	-ешь	2.	-ете
3.	-етъ	3.	-ютъ

Examples

Получа́ть	(pa-lu-chát'),	*to receive.*
Сочиня́ть	(sa-chi-nyát),	*to compose, to draw up, to draft.*
Имѣть	(i-myét),	*to have, to be in possession of.*

Conjugations

Sing.	*Plur.*
1. Я получа́ю, *I receive.*	1. Мы получа́емъ, *we receive.*
2. Ты получа́ешь, *thou receivest.*	2. Вы получа́ете, *you receive,* m.
3. Онъ получа́етъ, *he receives.*	3. Они́ получа́ютъ, *they receive.*
3. Она́ получа́етъ, *she receives.*	3. Онѣ получа́ютъ, *they receive,* f.
3. Оно́ получа́етъ, *it receives.*	3. Они́ получа́ютъ, *they receive,* n.
1. Я сочиня́ю, *I compose.*	1. Мы сочиня́емъ, *we compose.*
2. Ты сочиня́ешь, *thou composest.*	2. Вы сочиня́ете, *you compose.*
3. Онъ сочиня́етъ, *he composes.*	3. Они́ сочиня́ютъ, *they compose,* m.
3. Она́ сочиня́етъ, *she composes.*	3. Онѣ сочиня́ютъ, *they compose,* f.
3. Оно́ сочиня́етъ, *it composes.*	3. Они́ сочиня́ютъ, *they compose,* n.

1. Я имѣю, *I have.*	1. Мы имѣемъ, *we have.*
2. Ты имѣешь, *thou hast.*	2. Вы имѣете, *you have.*
3. Онъ имѣетъ, *he has.*	3. Они́ имѣютъ, *they have,* m.
3. Она́ имѣетъ, *she has.*	3. Онѣ имѣютъ, *they have,* f.
3. Оно́ имѣетъ, *it has.*	3. Они́ имѣютъ, *they have,* n.

NOTE.—Verbs like the above ending in **ешь** in the second person singular come under the first or **e** Conjugation, and keep the vowel **e** until third person plural, in which it changes into **ю**.

Practice III

Conjugate the following :

Рабо́тать	(ra-bó-tat'),	*to work.*
Покупа́ть	(pa-ku-pát'),	*to buy.*
Понима́ть	(pa-ni-mát'),	*to understand.*
Жела́ть	(zhe-lát'),	*to wish.*
Спра́шивать	(sprá-shi-vat'),	*to ask, question, demand.*
Объясня́ть	(ap-yas-nyát'),	*to explain.*
Провѣря́ть	(pra-vye-rát'),	*to check, verify.*
Направля́ть	(na-prav-lyát'),	*to direct.*
Красне́ть	(kras-nyét'),	*to blush.*
Толсте́ть	(tal-styét'),	*to grow thick, fatten.*

Practice IV

Find the infinitive of the following indicatives :

Одобря́емъ	(a-da-bryá-yem),	*we approve of.*
Забыва́ешь	(za-bü-vá-yesh),	*you forget* (singular 2).
Разсвѣта́етъ	(ras-svye-tá-yet),	*it dawns.*
Полага́ю	(pa-la-gá-yu),	*I presume.*
Темне́етъ	(tyem-nyé-yet),	*it's getting dark.*
Они́ теря́ютъ	(a-ní tye-rýá-yut),	*they lose.*
Вы чита́ете	(vwü chi-tá-ye-tye),	*you are reading.*
Она́ жале́етъ	(a-ná zha-lyé-yet),	*she regrets.*
Отправля́ю	(at-prav-lyá-yu),	*I am sending off.*
Черне́ютъ	(cher-nyé-yut),	*they become black.*

Practice V

Translate into English the following :

Жале́ю, жела́ешь, онѣ чита́ютъ, онъ рабо́таетъ, па́даешь, понима́емъ, не жела́емъ, полага́ю, вы теря́ете, онъ оскорбля́етъ, я приготовля́ю.

Practice VI

Translate into Russian the following :

He is falling, we understand, thou dost not know, we regret, I am losing, they are asking (questioning), you are working, she blushes, we are verifying, it dawns.

VOCABULARY

Что	(shto),	*what.*
Тепе́рь	(tye-pyér'),	*now.*
Дѣлать	(dyé-lat'),	*to do, make.*
Провѣрять	(pra-vye-ryát'),	*to check, verify.*
Счётъ	(schot),	*invoice.*
Имѣть	(i-myét'),	*to have.*
Вашъ, à.	(vash),	*your.*
Другъ	(drukh),	*friend.*
Мануфакту́рное	(ma-nu-fak-túr-no-ye),	*a drapery.*
Дѣло	(dyé-lo),	*business.*
Когда́	(kag-dá),	*when.*

Рабо́тать	(ra-bó-tat'),	*to work.*
Постоя́нно	(pa-sta-yán-no),	*continually.*
Ру́сскій	(rús-ski *),	*the Russian.*
Рубль	(rubl'),	*rouble.*
Па́дать	(pá-dat'),	*to fall.*
Мно́го	(mnó-go),	*much.*
Теря́ть	(tye-ryát'),	*to lose.*
Почему́	(pa-che-mú),	*why ?*
Красне́ть	(kras-nyét'),	*to blush.*
Дѣйстви́тельно	(dyeĭst-vi-tyel'-no),	*really.*
не	(nye),	*not.*
Понима́ть	(pa-ni-mát'),	*to understand.*
Кого́	(ka-vó),	*whom.*
Здѣсь	(zdyes'),	*here.*
Знать	(znat'),	*to know.*
Фабрика́нтъ	(fa-bri-kánt),	*manufacturer.*
Инжене́ръ	(in-zhe-nyér),	*engineer.*
Какъ	(kak),	*how.*
Смѣть	(smyet'),	*to dare.*
Оскорбля́ть	(as-kar-blyát'),	*to insult.*
Покупа́тель	(pa-ku-pá-tyel'),	*the customer, buyer.*
Презира́ть	(pre-zi-rat'),	*to despise.*
Лѣня́й	(lyen-tyái),	*idler.*
Бухга́льтеръ	(bukh-hál'-tyer),	*bookkeeper.*
Приготовля́ть	(pri-ga-tav-lyát'),	*to prepare.*
Свой	(svoi),	*his.*
Бала́нсъ	(ba-láns),	*balance-sheet.*
Ста́чка	(stách-ka),	*the strike.*
Причиня́ть	(pri-chi-nyat'),	*to cause.*
Засто́й	(za-stoi),	*stagnation.*
въ дѣла́хъ	(v-dye-lákh),	*in business.*
Хозя́инъ	(kha-zyá-in),	*the master.*
Покупа́ть	(pa-ku-pát'),	*to buy.*
Автомоби́ль	(af-ta-ma-bíl'),	*automobile.*
Просма́тривать	(pra-smá-tri-vat'),	*to look through.*
Гла́вная кни́га	(glav-na-ya kni-ga),	*the ledger.*
Выпи́сывать	(vwu-pi-su-vat'),	*to write out.*
Квита́нція	(kvi-tan-tsi-ya),	*a receipt.*
Честь	(chest'),	*the honour.*
Ва́шего, m. accus.	(va-she-vo †),	*your.*
Представи́тель, m.	(pret-sta-ví-tyel'),	*representative.*
Спра́шивать	(sprá-shi-vat'),	*to ask.*
Ва́ше, n.	(vá-she),	*your.*
Мнѣніе	(mnyé-ni-ye),	*opinion.*
и	(i),	*and.*
Совѣтъ	(sa-vyét),	*advice.*
Умѣть	(u-myét'),	*to be able, to know how to do.*
Чита́ть	(chi-tát'),	*to read.*
по ру́сски	(pa-rús-ski),	*Russian.*
обѣща́ть	(a-bye-shchát'),	*to promise.*
но́вый	(no-vwü),	*new.*
Зака́зъ	(za-kás ‡),	*an order.*
Кассова́я кни́га	(kas-sa-vá-ya kní-ga),	*the cash-book.*
Дне́вникъ	(dnyév-nik),	*the day-book.*
Предла́гать	(pred-la-gat'),	*to offer.*
намъ, dat.	(nam),	*to us.*
Това́ръ	(ta-var),	*goods.*
Одобря́ть	(a-da-bryát'),	*to approve of.*
На́шу, f., accus.	(ná-shu),	*our.*
Цѣна́	(tsye-ná),	*price, quotation.*
Уби́токъ	(u-bwü-tok),	*a loss, damage.*
Конча́ть	(kan-chát'),	*to finish.*
Рабо́та	(ra-bó-ta),	*the work.*
Пишу́щая маши́на	(pi-shú-shcha-ya ma-shí-na),	*typing machine.*
Шве́йная маши́на	(shvéĭ-na-ya ma-shí-na),	*sewing machine.*
почему́	(pa-che-mú),	*why.*
удовлетворя́ть	(u-dav-lyet-va-ryát'),	*to satisfy.*
забыва́ть	(za-bwü-vát'),	*to forget.*
франкъ	(frank),	*the franc.*
ре́дко	(ryét-ko),	*seldom.*
гуля́ть	(gu-lyát'),	*to have a walk, to go idle.*
колле́кція	(kal-lyék-tsi-ya),	*a set* (of samples, etc.).
одно́, n.	(a-dnó),	*one.*
сло́во	(sló-vo),	*word.*
означа́ть	(a-zna-chát'),	*to signify.*
э́то	(é-to),	*this.*
по-англійски	(pa-an-glí-ski),	*in English.*
Подпи́сывать	(pat-pí-su-vat'),	*to sign.*
Письмо́	(pis'-mó),	*a letter, correspondence.*
Закрыва́ть	(za-krü-vát'),	*to close.*
Отворя́ть	(a-tva-ryát'),	*to open.*
Дверь	(dvyer'),	*door.*

* u is always long.

† genitive ending -го is always pronounced -vo.

‡ s is always heard as "ss."

Exercise 1

Translate the following into English :

1. Что Вы тепе́рь дѣлаете ?
2. Я провѣря́ю Вашъ счётъ.
3. Что имѣетъ Вашъ другъ ?
4. Онъ имѣетъ мануфакту́рное дѣло.
5. Когда́ ты рабо́таешь ?
6. Я рабо́таю постоя́нно.
7. Когда́ ру́сскій рубль па́даетъ, мы мно́го теря́емъ.
8. Почему́ они́ красне́ютъ ?
9. Мы дѣйстви́тельно не понима́емъ.
10. Кого́ Вы здѣсь зна́ете ?
11. Мы здѣсь зна́емъ фабрика́нта Б. и инжене́ра Д.
12. Какъ смѣетъ онъ оскорбля́ть покупа́теля ?
13. Я презира́ю лѣня́я.
14. Бухга́льтеръ приготовля́етъ свой бала́нсъ.
15. Ста́чка причиня́етъ засто́й въ дѣла́хъ.
16. Хозя́инъ покупа́етъ автомоби́ль.
17. Мы просма́триваемъ гла́вную кни́гу.
18. Я выпи́сываю квита́нцію.
19. Мы имѣемъ честь знать Ва́шего представи́теля
20. Я спра́шиваю Ва́ше мнѣніе и совѣтъ.

Exercise 2

Translate the following into Russian :

1. I am able to read Russian.
2. The customer is promising (say : promises) a new order.
3. We check the cash-book (say : Кассовую книгу).
4. The master looks through the day-book.
5. The manufacturer offers us his goods.
6. They approve of our price.
7. The strike causes us losses (say : loss).
8. We finish our work.
9. I am buying (say : I buy) a typewriter.
10. She has a sewing machine.
11. Why don't you satisfy the customer ?
12. You are forgetting that the franc is now falling (say : falls).
13. We are very seldom idling about (гулять).
14. I am preparing (I prepare) a new set (коллекція).
15. I am only (лишь) asking (I ask) one word.
16. What signifies (does . . . signify) this word in English ?
17. The master signs the letter.
18. Why do you close (you close) the ledger ?
19. He opens the door.
20. I am closing (I close) the door.

A. C.

Continued from page 163.

GEOGRAPHY:

Contributors:—Robert Finch, F.R.G.S.; W. H. Koebel; Sir John Scott-Keltie, LL.D.; Cyril J. Silverston, B.Sc.(Lond.).

WINDS

THE atmosphere or air is a mixture of gases consisting principally of Oxygen and Nitrogen which surrounds the earth. When at rest we do not perceive it, but when in motion it becomes very apparent, since it imparts its movement to light bodies such as leaves and dust. Being a material substance, the atmosphere possesses weight, which can be measured by a barometer that registers the pressure caused by the atmosphere, and we find that by taking readings of a barometer at different times, this pressure, and consequently the weight, of the atmosphere is variable. Barometers are usually constructed of mercury, as the length of a column of this substance (B-T in the tube V, Fig. 34), which is equivalent to the average weight of the atmosphere, is of a convenient size, viz. 30 inches, and the pressure of the atmosphere is always spoken of as being equal to the height of a mercury column that it can support at any time.

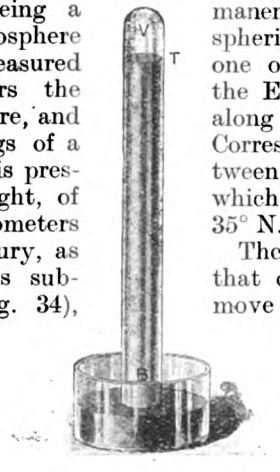


Fig. 34.—THE BAROMETER in its simplest form. The weight of a column of Mercury (B.-T.) 30 inches high equals the average weight of the atmosphere.

The barometer also gives information about the weather.

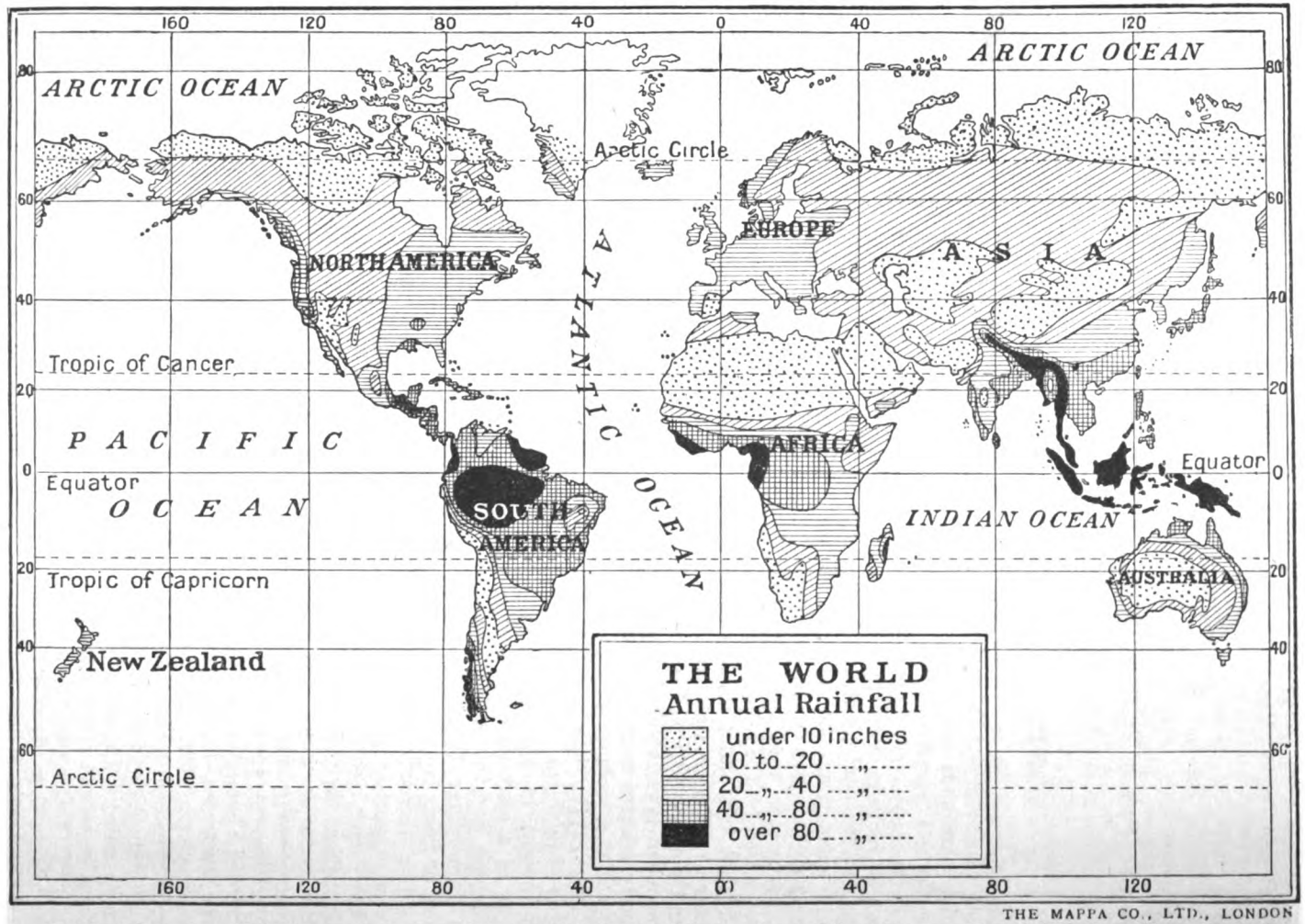
Another use to which the barometer may be put is in the determination of heights. As we ascend a mountain the amount of air above us decreases, and consequently the pressure becomes less. This decrease of pressure is registered by the barometer, and affords an indication of the height to which we have ascended. The average decrease of pressure as we ascend into the atmosphere is 1 inch for 900 feet up to about 1,500 feet.

Before we further consider the different winds of the earth, it is advisable to call attention to the fact that a wind is named from the direction *from which* it is blowing. An ocean current is named by the direction *towards which* it flows.

Permanent winds are established if the differences of pressure which give rise to them continue throughout the year. If these differences arise only at definite intervals the winds are spoken of as Periodic. Variable winds are the result of casual differences of pressure in adjacent regions. Now, there are three permanent areas or belts of low atmospheric pressure surrounding the earth: one of these lies just to the north of the Equator, the others approximately along the Arctic and Antarctic Circles. Corresponding with these and lying between them are two high-pressure belts which lie more or less along latitude 35° N. and 30° S.

The earth is revolving with a velocity that causes places on the Equator to move at the rate of over a thousand miles an hour, though the Poles themselves are at rest. Places intermediate in position between the Poles and the Equator move, of course, with intermediate velocities. Remembering this, let us consider what will be the effect of a body of air moving from the high-pressure belt situated in about latitude 35° N. towards the Equator. If the earth were at rest this would obviously produce a north wind; but the earth is moving towards the west, and the actual direction of the wind is consequently the product of these two directions—the north to south direction which the wind would take if the earth were at rest, and the east to west direction imposed by the actual movement of the earth. The consequence is that we get a wind which is a resultant of these two winds, moving from N.E. to S.W., that is a north-east wind.

These permanent winds are known as the North-East Trade Winds. On the other side of the Equator a little consideration will



THE MAPPA CO., LTD., LONDON

A rainfall of less than 12 inches per annum produces semi-desert conditions. A rainfall of between 12 and 20 inches allows of grazing, but a heavier fall is required for agriculture. The excessive rainfall experienced in some tropical regions serves only to produce a vegetation rank in its luxuriance.

show us that the corresponding wind will be a South-East Trade Wind, and this is actually the fact.

Along the line where N.E. and S.E. trade winds meet is a region of calms, or, at any rate, a region of variable winds caused by local differences of pressure, known to sailors as the Doldrums.

If we now consider the winds caused by the motion of the atmosphere from the high-pressure belt in latitude 35° N. towards the North Pole we shall by a similar process of reasoning see that the actual direction of the wind which, were the earth at rest, would be from south to north is deflected by reason of the earth's rotation to a direction from south-west to north-east. This gives us the south-west wind so prevalent in our own country, and which sometimes goes by the name of the Anti-trade Wind. Similarly in the southern hemisphere we get anti-trades from the north-west (Fig. 35).

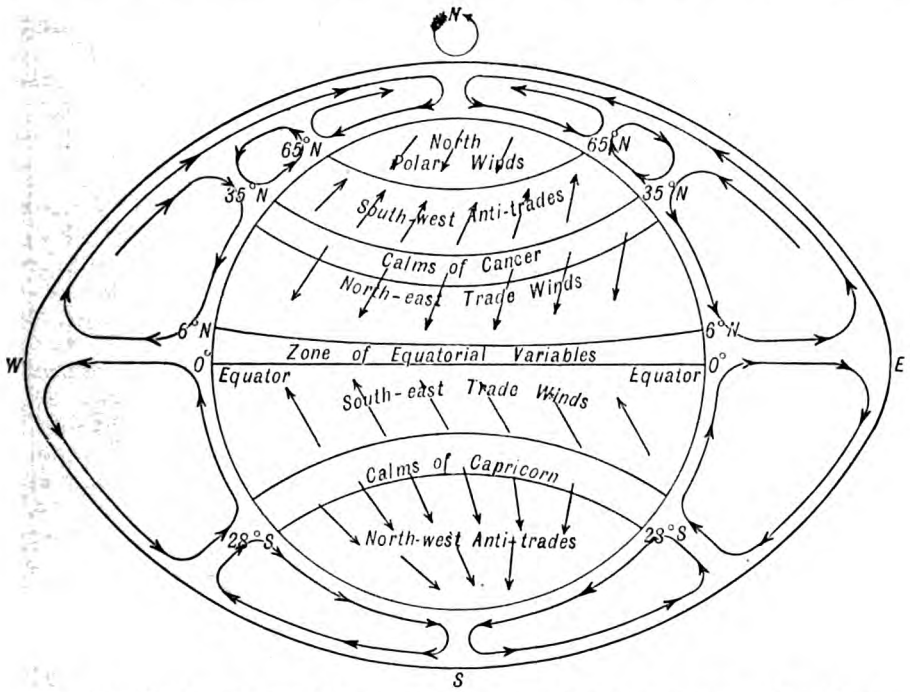


Fig. 35.—Diagram showing the general direction of winds on the earth's surface.

The term Anti-trade Wind applied to these winds is not, perhaps, strictly speaking, correct. It is obvious that we cannot have a current of air such as the north-east trades blowing continuously unless the air thus displaced goes somewhere. What happens is that by the action of convection the air rises and blows, in the upper part of the atmosphere, in a direction contrary to that in which it blows on the surface, thus forming a kind of vortex. And to these winds blowing in the upper air, imperceptible of course at the earth's surface, and in a contrary direction to the wind there, the term "anti-trades" is frequently given.

In the Indian Ocean the action of the trade winds is altered owing to the presence of the great land masses of Central Asia and of Australia. The presence of these great areas of land and the fact that the "Heat Equator" (or the line joining the hottest place on each meridian) alters as the seasons progress, and the sun's apparent daily path is to the north or south of the Equator, disturbs the action of what would be trade winds in this region and gives rise to the Monsoons. If the principles underlying the production of winds have been grasped, it should be easy for the reader to trace the course of the monsoon winds.

Near the sea, and particularly in the tropics, where the sun's heating action is more powerful, there are well-marked winds, Land and Sea Breezes, which are the consequence of the different heating effect noticed above of the sun on land and water. A little consideration should show us that these should blow out from the land after sunset and in from the sea when the sun is again high in the heavens (Figs. 37, 38).

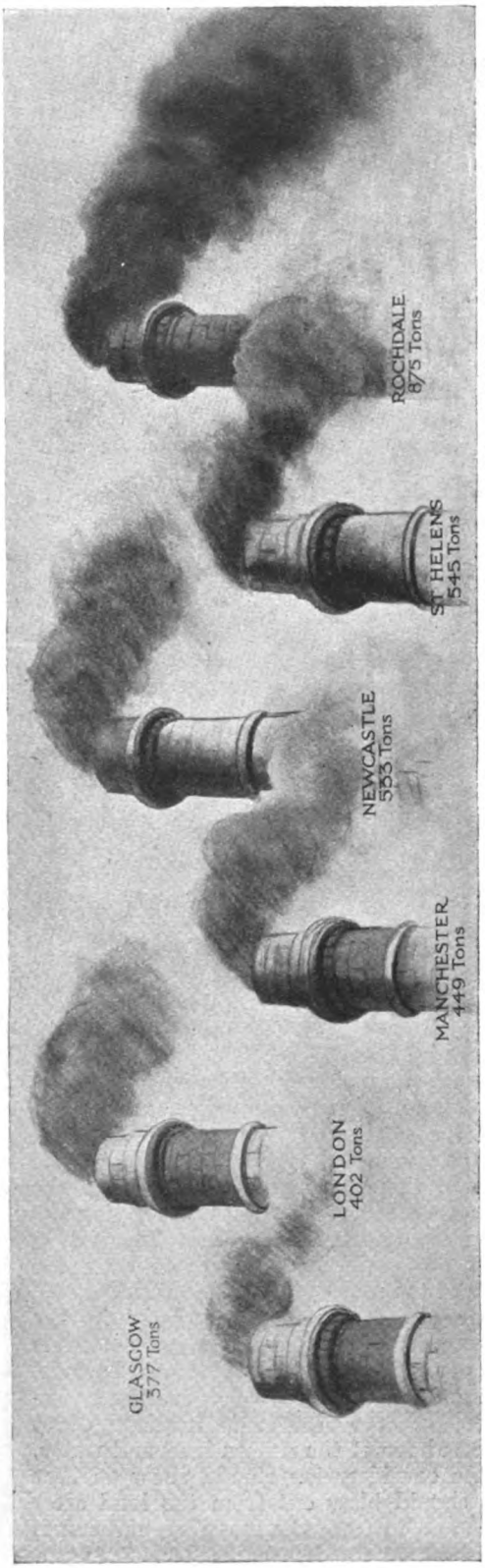


Fig. 36.—Diagram showing the amount of dirt deposited during a single year by the chimneys of six towns of Great Britain. Rochdale leads with 875 tons per square mile. This may be compared with Malvern's 80 tons. Thick town fogs owe their opacity to the large amount of carbon held in suspension by the atmosphere.

The atmosphere, as we have mentioned before, contains a quantity of water vapour in suspension which has been evaporated by the heat of the sun from the surface of the oceans, lakes, rivers, etc., of the earth. This water vapour sometimes becomes visible in the form of rain, mist, clouds, fog, snow, hail, frost, or dew. All these are merely different forms of water, and their cause is the exact opposite of evaporation, namely, condensation.

Since air can only retain a certain amount of water vapour, and since this amount depends upon the temperature—air at a high temperature being able to retain more than air at a low temperature—condensation is effected whenever, by reason of cooling, the air is unable to hold in suspension the amount of water vapour it contains.

Rain and its Origin

Rainfall is measured by the amount of water which would have fallen in any region if it could all have been collected and distributed evenly over the whole surface of that region. It is actually measured in a rain-gauge, in which instrument the rain falling on the surface of a funnel of known area is led into a vessel and then accurately measured in a graduated jar.

The principal causes of rain may be summarised as follows :—

(*a*) The rising of a current of moist air into rarer and cooler regions of the atmosphere.

(*b*) The contact of warm, damp air with the colder surface of the land.

(*c*) The mixing of masses of warm and cold air.

The intensity of rainfall differs greatly in different regions of the earth. The heaviest precipitation occurs in the hottest regions of the globe, the heaviest recorded rainfall being about 464 inches in some parts of Assam. In Great Britain the rainfall varies from 20 to 40 inches, though it rises to as much as 135 inches in some parts, the Lake District, for example.

The effects of rainfall are, in general, fairly obvious, but it may be interesting to point out one or two facts showing the more or less direct connection between it and the various industries that are directly dependent on weather. In temperate climates, for instance, a rainfall of less than 12 inches per annum produces semi-desert conditions. A rainfall of from 12 to 20 inches per annum will allow of grazing, while above that agriculture is possible. Over 60 inches is

in general, too wet for agriculture. In the tropics 30 inches to 60 inches is the most favourable rainfall, as the vegetation is too rank if the rainfall is over this limit.

When the temperature of a cloud is below the freezing point of water it becomes condensed in a solid form. If, further, these descending particles pass through air which is also below freezing point the precipitation takes the form of *snow*. The forms of snow-flakes are often most beautiful, and are all combinations of hexagonal forms of crystals.

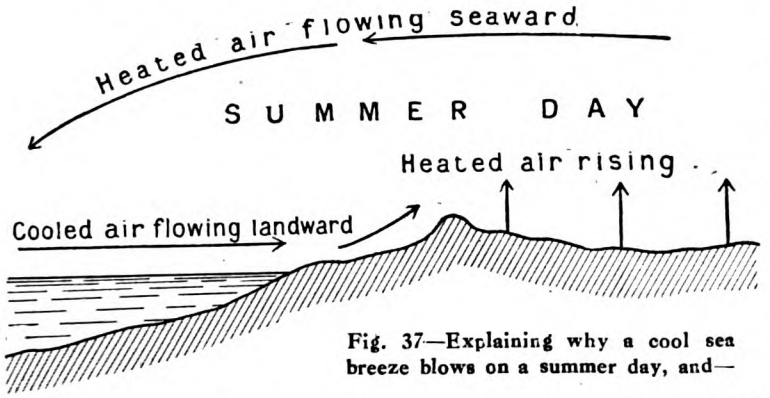


Fig. 37—Explaining why a cool sea breeze blows on a summer day, and—

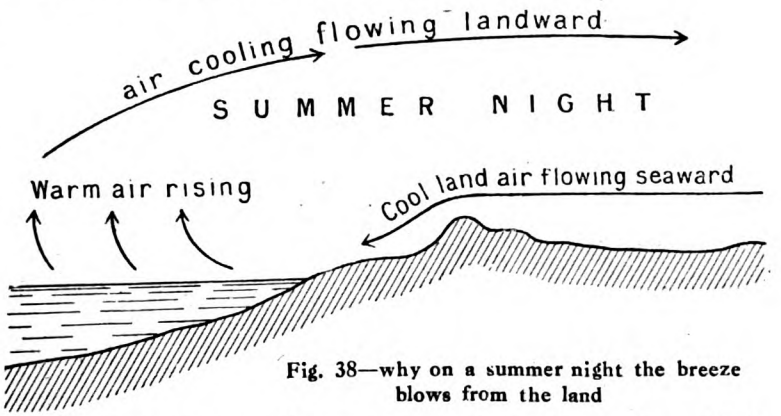


Fig. 38—why on a summer night the breeze blows from the land

Fogs are produced by the condensation of water vapour on dust particles, or by the mixing of bodies of air at different temperatures. The thick fogs which occur in large cities owe their opacity to the large amount of carbon held in suspension by the atmosphere. This is almost entirely due to the uneconomic manner in which we burn our coal (Fig. 36). More scientific methods of combustion would almost entirely free our great towns from this nuisance.

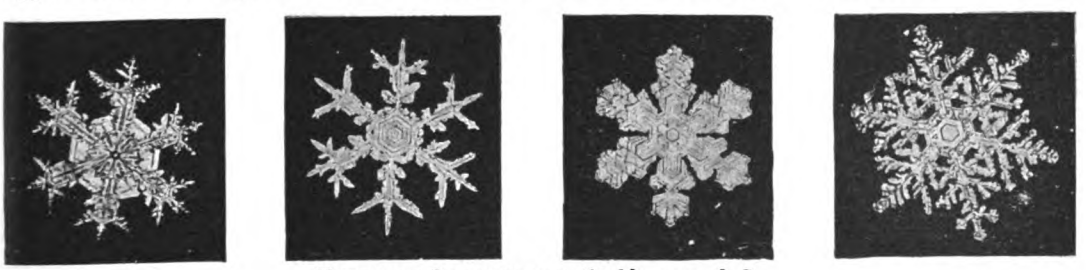
Clouds are thus mists produced in the upper air. Although one form of cloud easily passes into another, yet clouds conform to one of three types.

(1) Cirrus clouds—delicate detached and fibrous, often appearing by an effect of perspective to converge towards opposite sides of the horizon. They are composed of ice crystals, and have an average altitude of about 30,000 feet.

(2) Cumulus clouds—dome shaped, and rising from a flat base. These are of an average height of 5,000 feet.

(3) Stratus clouds are really a horizontal sheet of lifted fog. The ordinary rain cloud or Nimbus is a combination of cirro-stratus and cumulus.

Dew is deposited on the surface of the earth when the water vapour in the air close to the ground is condensed by the chilling influence of radiation. It cannot be formed if there is much wind, as then the air does not remain for sufficiently long in contact with the ground for precipitation to occur. If the sky is cloudy radiation is checked, and dew will not be formed. If the temperature is below freezing point, precipitation of hoar frost or rime occurs. C. J. S.



TYPES OF SNOW-FLAKE (*highly magnified*).

The forms of snow-flakes are all combinations of hexagonal crystals, and often take most beautiful shape.

Continued from page 170

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.

(M. A. Lewenz, M.A.[Lond.]).

ARITHMETIC.—XII

We shall now give a number of examples illustrating the practical applications of what we have already learned.

Examples:—

(1) A man buys 350 feet of carpet at 6s. 9d. a foot, and sells it at 7s. 6d. a foot. What was his profit?

His profit on one foot = 7s. 6d. — 6s. 9d. = 9d.
∴ his total profit = (350 × 9)d. = 262½s.
= **£13 2s. 6d.**

(2) A servant's wages are £12 7s. a year. How much ought he to receive for 7 weeks, supposing a year to consist of 52 weeks?

For 1 week he should receive $\frac{1}{52}$ of £12 7s.
∴ for 7 weeks he should receive $\frac{7}{52}$ of £12 7s.
$\frac{7}{52}$ of £12 7s. = $\frac{7}{52}$ of £12$\frac{7}{20}$ = $\frac{7}{52}$ of £$\frac{247}{20}$
= £$\frac{7 \times 247}{52 \times 20}$ = **£1 13s. 3d.**

(3) How many rails weighing 4 cwt. 3 qr. 7 lb. can be made out of 121 tons 2 qr. 21 lb. of iron? What will each rail cost at 1½d. a lb.?

The number of rails is found by dividing 2 tons 2 qr. 21 lb., which equals 2420$\frac{11}{16}$ cwt., by 4 cwt. 3 qr. 7 lb., which equals 4$\frac{13}{16}$ cwt.
∴ the number of rails = 2420$\frac{11}{16}$ ÷ 4$\frac{13}{16}$
= $\frac{38731}{16} \times \frac{16}{77}$ = **503.**

Again 4 cwt. 3 qr. 7 lb. = 539 lb.
∴ each rail will cost (539 × $\frac{3}{2}$)d. = $\frac{539}{8}$s.
= 67⅜s. = **£3 7s. 4½d.**

(4) How many revolutions will a wheel, which measures 4 yards round its circumference, make in half a mile?

Half a mile = $\frac{1}{2}$ of 1760 yd. = 880 yd.
In one revolution the wheel passes over 4 yards,
∴ in passing over 880 yd. the number of revolutions it will make = $\frac{880}{4}$ = **220.**

(5) The sum of £12 1s. 4d. has to be paid by several persons, each paying an equal share. It is found that 10 of these persons have to pay altogether £3 15s. 5d. How many were there to share the whole cost?

If 10 people pay altogether £3 15s. 5d. then each one pays $\frac{1}{10}$ of £3 15s. 5d. = 7s. 6½d.
∴ the number who share the whole cost is found by dividing £12 1s. 4d. by 7s. 6½d., i.e. by seeing how many times 7s. 6½d. is contained in £12 1s. 4d.

$$\frac{\text{£12 1s. 4d.}}{\text{7s. 6½d.}} = \frac{241\frac{1}{3}\text{s.}}{7\frac{1}{24}\text{s.}} = \frac{724}{3} \times \frac{24}{181} = \mathbf{32.}$$

(6) How many sovereigns, half-crowns, shillings, and sixpences go to make up £5,760, supposing there are an equal number of each of the coins?

1 sovereign + 1 half-crown + 1 shilling + 1 sixpence = (40 + 5 + 2 + 1) sixpences = **48 sixpences.**

£5,760 = (5760 × 40) sixpences = **230,400 sixpences.**

We must find how many times 48 sixpences are contained in 230,400 sixpences.
∴ number required = $\frac{230400}{48}$ = **4,800.**

(7) A person buys 100 gallons of wine at 7s. 6d. a gallon. How much water must he add to it in order to gain £4 10s. on his outlay, if he retails the mixture at 1s. 2d. a quart?

His outlay = (100 × 1$\frac{5}{2}$)s. = **£37 10s.**
He is to gain £4 10s.
∴ he must sell the mixture for £37 10s. + £4 10s. = £42.

1s. 2d. a quart = (4 × 1$\frac{1}{6}$)s. a gallon = 4$\frac{2}{3}$s. a gallon.

How many gallons must he sell at this price in order to receive £42? Since £42 = 840s. the required number is $\frac{840}{4\frac{2}{3}}$ = 180.

Since he must sell 180 gallons, and he has bought only 100 gallons of wine, he must add (180 — 100) gallons of water, i.e. **80 gallons of water.**

(8) A cycles at the rate of 10 miles an hour, and after he has gone 24 miles B follows him at the rate of 14 miles an hour. How long will it take B to overtake A?

B has to go 24 miles more than A.
Each hour he travels (14 — 10) or 4 miles more than A, ∴ $\frac{24}{4}$ or 6 is the number of hours he will require to overtake A.

(9) The cost of travelling third class on the Swiss railways is 5·2 centimes per kilometre, and luggage is charged for at the rate of 5 centimes per 100 kilogramme per kilometre. Find the greatest number of lb. of luggage a traveller can take with him so that his total expenditure shall not exceed 1d. per mile.

1 kilometre = ·6214 mile, 1 kilogramme = 2·205 lb., 25 francs = £1 (*London Matriculation Examination, January,* 1910).

1 penny per mile
$= \frac{25}{240}$ francs per mile
$= \frac{25}{240}$ francs per $\frac{1}{6214}$ kilometres
$= \frac{25}{240} \times 6214$ francs per kilometre
$= 064729\ldots$ francs per kilometre
$= 6{\cdot}4729\ldots$ centimes per kilometre

Since the traveller's own fare = 5·2 centimes per kilometre, he must not pay more than (6·4729.... —5·2) or 1·2729....centimes per kilometre for his luggage.

Now 100 kilogrammes can be carried for 5 centimes per kilometre.

∴ 20 kilogrammes can be carried for 1 centime per kilometre.

∴ the weight of luggage must not exceed
1·2729.... × 20 kilogrammes
= 25·458....kilogrammes
= 25·458.... × 2·205 lb.
= **56·13 .... lb.**

∴ the weight of his luggage must not exceed 56·13....lb. or 56 lb. to the nearest lb.

(10) A steamer leaves New York for Liverpool at noon (New York time) on Saturday, and travels at an average speed of 28 miles per hour. Another steamer leaves Liverpool for New York at 3 P.M. (Greenwich time) on Saturday and travels at an average speed of 24 miles per hour. The distance is 3,045 miles, and it is 4.45 P.M. at Liverpool when it is mid-day at New York. When and where do the steamers meet? (*London Matriculation Examination, January*, 1908.)

First steamer leaves New York at noon (New York time), i.e. at 4.45 P.M. (Greenwich time). The second steamer leaves Liverpool at 3 P.M. (Greenwich time).

∴ the second steamer starts $1\frac{3}{4}$ hours before the first, and has ∴ travelled $(24 \times 1\frac{3}{4})$ or 42 miles when the first steamer starts.

At that time the distance between the two must be (3045 — 42) or 3,003 miles.

They approach each other at a speed of (28 + 24) or 52 miles per hour.

∴ they will meet after $\frac{3003}{52}$ or $57\frac{3}{4}$ hours after the first steamer starts from New York.

$57\frac{3}{4}$ hours = 2 days $9\frac{3}{4}$ hours.

∴ they will meet on Monday 9.45 P.M. (New York time), that is, Tuesday 2.30 A.M. Greenwich time.

The steamer from New York will have travelled $(57\frac{3}{4} \times 28)$ or 1,617 miles.

∴ the steamers meet 1,617 miles from New York, or 1,428 miles from Liverpool.

Exercise 34

(1) What fraction of 2 cwt. is 3 qr. 4 lb.?

(2) What fraction of 50s. is $2\frac{1}{2}$ guineas?

(3) What fraction of half a crown is $\frac{2}{5}$ of $\frac{4}{7}$ of a guinea?

(4) What fraction of $4\frac{1}{2}$ guineas is $5\frac{5}{8}$ of $1\frac{4}{15}$ of £14.

(5) Compare the values of $\frac{5}{8}$ of £1, $\frac{5}{6}$ of a guinea, and $\frac{8}{9}$ of 14s. $7\frac{1}{2}$d.

(6) Which is greater, $\frac{1}{30}$ of a day or $\frac{3}{4}$ of an hour? And by how much?

(7) Subtract $\frac{5}{8}$ of a crown from £1·59476.

(8) Reduce $6\frac{1}{2}$ guineas to the decimal of £10; and $1\frac{1}{2}$d. to the decimal of £50.

(9) Reduce $\frac{3}{5\cdot5}$ of £1 2s. 6d. + $\frac{7}{8}$ of $\frac{1}{5}$ of 4d. — $\frac{4}{5}$ of $\frac{1}{5\cdot6}$ of 3s. 1d. to the decimal of £49 0s. 5d.

(10) Add together ·5125 of a yard, ·6273 of a pole, and ·018325 of a furlong; subtract the result from ·0049 of a mile, and express the answer in yards.

(11) Express an inch as a decimal of a metre, having given that 1 metre = 39·37079 inches.

(12) Given that 1 m. = 39·37079 in. and that 1 cubic foot of water weighs 62·42 lb., show that 1 lb. = 453·6 grammes.

Exercise 35

The following have been set at the London Matriculation Examinations:—

(1) Simplify $\dfrac{2\frac{1}{3} - 1\frac{2}{5}}{3\frac{1}{3} + 1\frac{2}{5}} \div \dfrac{\frac{2}{7} - \frac{1}{8}}{\frac{2}{7} + \frac{1}{8}}$

(2) If the same kind of tobacco is sold in England at $6\frac{1}{2}$d. per ounce, and in France at 13 fr. 50 centimes per kilogramme, find to the nearest farthing by how much the English duty on tobacco exceeds that paid in France.

£1 = 25 fr. 1 kilogramme = 2·205 lb.

(3) Three men, A, B, and C, are required to fill a tank holding 450 gallons by carrying buckets of water. A pours in $3\frac{1}{2}$ gallons every 20 seconds, B pours in 4 gallons every 25 seconds, and C pours in $4\frac{1}{4}$ gallons every 30 seconds. If each pours in his first instalment at noon, find at what time the tank is filled, how many journeys each man has made, and which poured last.

(4) If $\pi = 3{\cdot}14159265\ldots$ and $e = 2{\cdot}71828182\ldots$ find (i.) to 3 places of decimals, (ii.) to 3 significant figures, the values of $\pi + e$, $10\pi - e$, $\pi \times e$, $\dfrac{\pi}{e}$, $\dfrac{e}{25\pi}$.

(5) Evaluate—

(i.) 26.607 × 1,493,721 correctly to the nearest million.

(ii.) $\dfrac{1}{266{\cdot}07 \times 0{\cdot}1493721}$ to the nearest thousandth.

(iii.) $\dfrac{1}{0{\cdot}26607} + \dfrac{1}{14{\cdot}93721}$ to three significant figures.

(6) A sheet of metal weighs $4\frac{1}{2}$ lb. to the square foot. How many kilogrammes to the square metre is this? Give your answer to the nearest kilogramme.

A metre = 39·370 in.; a gramme = 0·0353 oz.

Key to Exercise 33

(1) £79 16s. 3d.; £95 5s. 6d.; £151 12s. 10½d. £343 3s. 10½d.; £853 19s. 10½d.

(2) £288,848 7s.; £1,222,446 10s. 10½d.; £6,011,656 5s. 8½d.

(3) 1 ton 17 cwt. 2 qr. 14 lb.; 4 ton 2 qr. 14 lb.; 8 ton 6 cwt. 2 qr. 14 lb.

(4) 39 yd. 1 ft. 4 in.; 2 fur. 14 po. 8 yd. 2 ft.; 1 mile 20 po. 3 yd. 1 ft. 10 in.

(5) 134 ac. 1 ro.; 542 ac. 1 ro. 28 sq. po.; 9 sq. m. 124 ac. 2 ro. 20 sq. po.

(6) 2 qr. 2 bush. 1 gal.; 5 qr. 5 bush. 1 pk. 2 qt.; 6 qr. 5 bush. 3 pk. 1 gal. 1 qt. 1 pt.; 15 qr. 3 bush. 2 pk. 1 gal. 3 qt.

(7) 158 days 14 hr. 50 min. 24 sec.; 338 days 21 hr. 23 min. 24 sec.; 1,317 days 21 hr. 51 min.

(8) £51 0s. 9¼d. (9) £6 7s. $4\frac{24}{25}\frac{7}{25}$d.

(10) 2 ac. 3 ro. 27 sq. po. 19 sq. yd. 7 sq. ft. $1\frac{5}{13}$ sq. in.

(11) 3 cwt. 1 qr. 14 lb. (12) 3 bush. 3 pk. 1 gal. 3 qt. 1 pt. $1\frac{1}{167}$ gills.

(13) 97. (14) 30. (15) 279. (16) 22.

(17) (i.) £1,171 3s. $9\frac{7}{76}$d.; (ii.) £5 9s. $5\frac{13}{18}$d.

(18) (i.) 45 yd. 2 ft. $7\frac{2}{3}$ in.; (ii.) 33 yd. $1\frac{1}{2}$ in.

(19) £19 0s. 4·8252d. (20) £1 11s. 1·97d.

(21) $\frac{1}{6}$. (22) $\frac{1}{20}$.

M. A. L.

ALGEBRA.—XII

81. The roots of a Quadratic Equation.

We have seen that the equation $ax^2 + bx + c = 0$ has two roots in general, namely

$$x = -\frac{b}{2a} + \sqrt{\frac{b^2-4ac}{4a^2}} \text{ and } x = -\frac{b}{2a} - \sqrt{\frac{b^2-4ac}{4a^2}}$$

Now $4a^2$ is always positive and $\therefore \sqrt{4a^2}$ is always real.

Hence $\sqrt{\frac{b^2-4ac}{4a^2}}$ is real or imaginary according as $b^2 - 4ac$ is positive or negative.*

Thus both roots are real or imaginary according as $b^2 - 4ac$ is positive or negative, and both roots are rational or irrational according as $b^2 - 4ac$ is or is not a perfect square.

The student should note that we cannot have one root real or one imaginary, nor can we have one root rational and one irrational.

If $b^2 - 4ac = 0$, both roots reduce to $-\frac{b}{2a}$ and are thus equal. In this case the expression on the left is a perfect square and has two equal roots. Clearly the roots cannot be equal unless $b^2 - 4ac = 0$, and hence it is a necessary and sufficient condition for $ax^2 + bx + c$ to be a perfect square, that $b^2 = 4ac$.

82. (1) If $c = 0$ the equation becomes $ax^2 + bx = 0$

$\therefore x(ax + b) = 0$ $\therefore$ the roots are $x = 0$, $x = -\frac{b}{a}$

(2) If $c=0$ and $b=0$ the equation becomes $ax^2=0$ $\therefore$ both the roots are $x = 0$.

(3) If $b = 0$ the equation becomes $ax^2 + c = 0$

$\therefore x^2 = -\frac{c}{a}$ $\therefore x = \pm\sqrt{-\frac{c}{a}}$.

Hence the roots are equal in magnitude but opposite in sign when $b = 0$.

(4) If $a = 0$, $b = 0$, $c = 0$, the equation is true for all values of x.

(5) If $a = o, b = 0$ but $c \neq 0$, put $x = \frac{1}{y}$ then the equation $ax^2 + bx + c = 0$ becomes $\frac{a}{y^2} + \frac{b}{y} + c = 0$ and multiplying by y^2 we have

$$a + by + cy^2 = 0$$
$$\text{or } cy^2 + by + a = 0$$

Now by (1) and (2) above, one root is zero if $a = 0$ and both roots are zero if a and $b = 0$

but if $y = 0$, since $x = \frac{1}{y}$, $x = \frac{1}{0} = \infty$

$\therefore$ one root of $ax^2 + bx + c = 0$ is infinite if $a = 0$ and both roots are infinite if $a = 0$ and $b = 0$.

83. Fractional Equations.

If there be arithmetic or algebraic fractions in an equation, we may clear the equation of fractions by multiplying throughout by the product of the expressions which form the denominators of the fractions. Now let us consider the case in which one or more of these denominators are functions of x.

We have shown that in general the equation $RP = RQ$ has more solutions than the equation $P = Q$, when R is a finite function of x.

But if we multiply by the L.C.M. of the functions in the denominators, we shall not in general introduce extra solutions; for if we divide the integral equation obtained by multiplying throughout by the L.C.M., by any one of the factors, we shall reintroduce fractions.

To put it differently: the values of x which make any one of the factors of the L.C.M. equal to zero, would give the original equation an infinite term, and the theorem that $RP = RQ$ has more solutions than $P = Q$ depends on R, P and Q being finite.

Example:—

$$\frac{1}{x-1} + \frac{1}{x-2} + 1 = 0$$

Multiply by $(x - 1)(x - 2)$

then $(x - 2) + (x - 1) + (x^2 - 3x + 2) = 0$

$\therefore x^2 - x - 1 = 0$

$$\therefore x = \frac{1 \pm \sqrt{5}}{2}$$

If in the original equation we put $x = 1$, the first term becomes infinite.

However, cases may arise in which extraneous roots are introduced, thus,

$$\frac{x^2-2x}{x^2-4} - \frac{2}{x+2} + 1 = 0.$$

Multiplying by $x^2 - 4$ we have

$x^2 - 2x - 2x + 4 + x^2 - 4 = 0$

$\therefore 2x^2 - 4x = 0$

$\therefore 2x(x - 2) = 0$

$\therefore x = 0$ or $x = 2$

but if we consider the equation anew,

$$\frac{x^2-2x}{x^2-4} - \frac{2}{x+2} + 1 = 0$$

$$\therefore \frac{x^2-2x-2x+4}{x^2-4} + 1 = 0$$

$$\therefore \frac{(x-2)^2}{x^2-4} + 1 = 0$$

$$\therefore \frac{x-2}{x+2} + 1 = 0 \quad \therefore x - 2 + x + 2 = 0$$

$$\therefore 2x = 0 \quad \therefore x = 0.$$

Thus we see that this has only one root, $x = 0$, and that an extraneous root $x = 2$ has been introduced. The reason is that in the divisor $x^2 - 4$, which $= (x - 2)(x + 2)$ the factor $(x - 2)$ is superfluous since it cancels with the $(x - 2)$ x of the numerator.

The following examples will show how fractional equations may often be simplified by rearrangement.

Examples:—

(1) $$\frac{1}{x-8} + \frac{1}{x-6} + \frac{1}{x+6} + \frac{1}{x+8} = 0$$

$$\therefore \frac{1}{x-8} + \frac{1}{x+8} + \frac{1}{x-6} + \frac{1}{x+6} = 0$$

$$\therefore \frac{2x}{x^2-64} + \frac{2x}{x^2-36} = 0$$

$$\therefore 2x\left(\frac{1}{x^2-64} + \frac{1}{x^2-36}\right) = 0$$

one obvious root is $x = 0$.

* The student will remember that $(+a)^2 = +a^2$, and $(-a)^2 = +a^2$, i.e. that the square of any *real* quantity, whether positive or negative, is always positive, and that $\therefore \sqrt{-a^2}$ is not a real quantity.

The other root we obtain from

$$\frac{1}{x^2-64}+\frac{1}{x^2-36}=0$$

$\therefore x^2-36+x^2-64=0$

$\therefore 2x^2=100$

$\therefore x^2=50 \quad \therefore x=\pm\sqrt{50}=\pm 5\sqrt{2}$

$\therefore$ the roots are $x=0, x=\pm 5\sqrt{2}$

(2) $\dfrac{a+c}{x+2b}+\dfrac{b+c}{x+2a}=\dfrac{a+b+2c}{x+a+b}$

now $\dfrac{a+b+2c}{x+a+b}=\dfrac{a+c}{x+a+b}+\dfrac{b+c}{x+a+b}$

$\therefore$ transposing, $\dfrac{a+c}{x+2b}-\dfrac{a+c}{x+a+b}+\dfrac{b+c}{x+2a}-\dfrac{b+c}{x+a+b}=0.$

Taking the first and second terms together, and the third and fourth, we have

$$(a+c)\left(\frac{1}{x+2b}-\frac{1}{x+a+b}\right)+(b+c)\left(\frac{1}{x+2a}-\frac{1}{x+a+b}\right)=0$$

$$\therefore \frac{(a+c)(a-b)}{(x+2b)(x+a+b)}+\frac{(b+c)(b-a)}{(x+2a)(x+a+b)}=0$$

dividing by $(a-b)$

$$\frac{a+c}{(x+2b)(x+a+b)}-\frac{b+c}{(x+2a)(x+a+b)}=0$$

Multiplying by $(x+2a)(x+2b)(x+a+b)$

$(a+c)(x+2a)-(b+c)(x+2b)=0$

$\therefore (a-b)x+2\{a(a+c)-b(b+c)\}=0$

$\therefore (a-b)x=-2(a-b)(a+b+c)$

dividing by $(a-b)$ $\therefore x=-2(a+b+c)$

84. Irrational Equations

These are equations in which square or other roots of expressions containing the unknown quantity occur.

In order to rationalize such an equation, we must write it with one of the irrational terms alone on one side; then we raise both sides to the lowest power necessary to rationalize the term which stands alone, and then repeat the process as often as may be necessary until all the terms are rationalized.

In general the rationalized equation will contain extraneous solutions.

We shall only deal with equations which contain square roots.

If P, Q and R be functions of x, consider the irrational equation

$$\sqrt{P}+\sqrt{Q}-\sqrt{R}=0$$

Transposing, $\sqrt{P}+\sqrt{Q}=\sqrt{R}$

Squaring both sides, $P+Q+2\sqrt{PQ}=R$

Transposing, $P+Q-R=-2\sqrt{PQ}$

Squaring both sides, $(P+Q-R)^2=4PQ$

which is a rational equation.

Examples:—

(1) $\sqrt{2x+9}-\sqrt{x-4}=\sqrt{x+1}$

squaring, $2x+9+x-4-2\sqrt{(2x+9)(x-4)}=x+1$

$\therefore 2x+4=2\sqrt{(2x+9)(x-4)}$

dividing by 2, $x+2=\sqrt{(2x+9)(x-4)}$

squaring, $x^2+4x+4=2x^2+x-36$

$\therefore x^2-3x-40=0$

$(x-8)(x+5)=0$

$\therefore x=8$ or $x=-5$

(2) $\sqrt{a(a+b+x)}-\sqrt{a(a+b-x)}=x$

squaring, $a\{a+b+x+a+b-x\}$

$-2\sqrt{a^2\{(a+b)^2-x^2\}}=x^2$

$-x^2+2a(a+b)=2a\sqrt{(a+b)^2-x^2}$

squaring,

$x^4-4ax^2(a+b)+4a^2(a+b)^2=4a^2(a+b)^2$

$-4a^2x^2$

$x^4-4abx^2=0 \quad \therefore x^2(x^2-4ab)=0$

$\therefore x=0$ or $x=\pm 2\sqrt{ab}$

85. *To prove that a quadratic equation can not have more than two roots.*

Suppose the equation $ax^2+bx+c=0$ has three different roots $x=\alpha$, $x=\beta$, $x=\gamma$.

Then

$$a\alpha^2+b\alpha+c=0 \quad \ldots\ldots\ldots \text{(i)}$$

$$a\beta^2+b\beta+c=0 \quad \ldots\ldots\ldots \text{(ii)}$$

$$a\gamma^2+b\gamma+c=0 \quad \ldots\ldots\ldots \text{(iii)}$$

Subtracting (ii) from (i)

$a(\alpha^2-\beta^2)+b(\alpha-\beta)=0$

$\therefore (\alpha-\beta)\{a(\alpha+\beta)+b\}=0$

Now $\alpha-\beta\neq 0$ since $\alpha\neq\beta$

$\therefore a(\alpha+\beta)+b=0 \quad \ldots\ldots\ldots$ (iv)

Similarly from (ii) and (iii)

$$a(\beta+\gamma)+b=0 \quad \ldots\ldots\ldots \text{(v)}$$

Subtracting (v) from (iv)

$$a(\alpha-\gamma)=0 \quad \ldots\ldots\ldots\ldots \text{(vi)}$$

Now $\alpha-\gamma\neq 0$ since $\alpha\neq\gamma$

$\therefore$ (vi) can only be true if $a=0$.

But if $a=0$ it follows from (iv) that $b=0$, and if $a=0$ and $b=0$ it follows from (i) that $c=0$. Hence a quadratic equation cannot have more than two roots unless $a=0$, $b=0$, $c=0$, but in that case $ax^2+bx+c=0$ is satisfied for all values of x, i.e. it is an identity.

86. Relation between the roots and coefficients of a quadratic equation.

If α and β be the roots of the quadratic equation $ax^2+bx+c=0$

Then $\alpha=-\dfrac{b}{2a}+\sqrt{\dfrac{b^2-4ac}{4a^2}}$

$$\beta=-\frac{b}{2a}-\sqrt{\frac{b^2-4ac}{4a^2}}$$

by addition,

$$\alpha+\beta=-\frac{b}{a} \quad \ldots\ldots\ldots\ldots \text{(i)}$$

by multiplication,

$$\alpha\beta=\left(-\frac{b}{2a}\right)^2-\frac{b^2-4ac}{4a^2}$$

$$\therefore \alpha\beta=\frac{4ac}{4a^2}=\frac{c}{a} \quad \ldots\ldots\ldots\ldots \text{(ii)}$$

Examples:—

(1) Find the equation whose roots are 2 and 5. This must be an equation which is satisfied when $x=2$ and when $x=5$, i.e. when $x-2=0$ and when $x-5=0$.

The required equation is obviously

$$(x-2)(x-5)=0$$

i.e. $x^2-7x+10=0$

(2) If α and β be the roots of $x^2 - px + q = 0$, calculate the value of $\alpha^3 + \beta^3$

We know that $\alpha + \beta = p \ldots$.(i) $\alpha\beta = q \ldots$. (ii)

Square (1), then $\alpha^2 + 2\alpha\beta + \beta^2 = p^2$

$\therefore \alpha^2 + \beta^2 = p^2 - 2\alpha\beta$

$= p^2 - 2q$ (from (ii))

Now $\alpha^3 + \beta^3 = (\alpha + \beta)(\alpha^2 - \alpha\beta + \beta^2)$

$= p(p^2 - 2q - q) = p(p^2 - 3q)$

87. *To find the changes in the value of the expression $ax^2 + bx + c$ when x may have any real value between $-\infty$ and $+\infty$*

Suppose for some value of x

$ax^2 + bx + c = \lambda$

then $ax^2 + bx + (c - \lambda) = 0$

In order that the roots of this may be real

$b^2 - 4a(c - \lambda)$ must be > 0 (see § 81)

i.e. $b^2 - 4ac + 4a\lambda > 0 \ldots\ldots\ldots\ldots$ (i)

I. If $b^2 - 4ac > 0$, the condition (i) is satisfied if $4a\lambda$ be positive, and if $4a\lambda$ be negative, but not greater in absolute magnitude than $b^2 - 4ac$.

II. If $b^2 - 4ac < 0$ the condition (i) is satisfied if $4a\lambda$ is positive and not less in absolute magnitude than $b^2 - 4ac$.

III. If $b^2 - 4ac = 0$, condition (i) is satisfied for all positive values of $4a\lambda$.

It follows from the above that the expression $ax^2 + bx + c$ will always have the same sign whatever real value x may have, provided that $b^2 - 4ac$ is negative or zero; that is provided the roots of $ax^2 + bx + c = 0$ are equal or imaginary. Further, the expression may be made to change its sign when the roots of $ax^2 + bx + c = 0$ are real and unequal, i.e. when $b^2 - 4ac$ is positive.

88. We may prove this independently thus:

$$ax^2 + bx + c = a\left[\left(x + \frac{b}{2a}\right)^2 - \frac{b^2 - 4ac}{4a^2}\right]$$

I. Let $b^2 - 4ac$ be positive.

Then the expression in the square brackets will be *negative* if $x = -\frac{b}{2a}$.

Further, if x be sufficiently great $\left(x + \frac{b}{2a}\right)^2$ will be $> \frac{b^2 - 4ac}{4a^2}$ and the expression in the square brackets will be *positive*.

Hence we see that $ax^2 + bx + c$ may be made to change its sign by giving suitable values to x.

II. Let $b^2 - 4ac$ be negative or zero.

Then $\because \left(x + \frac{b}{2a}\right)^2$ is always positive for all real values of x, and $-\frac{b^2 - 4ac}{4a^2}$ is positive or zero, the expression in the square brackets must always be positive.

Hence in this case $ax^2 + bx + c$ will always have the same sign, and moreover it will be the same as the sign of a.

Thus we see that **if a quadratic expression in x can be made to change its sign, by assigning suitable values to x, then the roots of the corresponding equation must be real.**

Example:—

Show that $\frac{x^2 - x + 1}{x^2 + x + 1}$ lies between the values 3 and $\frac{1}{3}$ for all real values of x.

Put $\frac{x^2 - x + 1}{x^2 + x + 1} = \lambda$

then $(1 - \lambda)x^2 - (1 + \lambda)x + (1 - \lambda) = 0$

In order that this may be real it is necessary and sufficient that

$$(1 + \lambda)^2 - 4(1 - \lambda)^2 \geqq 0$$

$$\text{i.e. } -3\lambda^2 + 10\lambda - 3 \geqq 0$$

$$\text{i.e. } -(3\lambda - 1)(\lambda - 3) \geqq 0$$

Hence $3\lambda - 1$ and $\lambda - 3$ must be of *different* signs.

$\therefore \lambda$ must lie between the values $\frac{1}{3}$ and 3.

Exercise 15

Solve the equations—

(1) $\frac{42}{x - 2} = \frac{35}{x - 3}$. (2) $x + 1 - \frac{x^2 + 3}{x + 2} = 2$.

(3) $\frac{x}{x - 2} - \frac{x + 1}{x - 1} - \frac{x - 8}{x - 6} + \frac{x - 9}{x - 7} = 0$.

(4) $\frac{x^2 - a^2}{bx} - \frac{a - x}{b} = \frac{2x}{b} - \frac{a}{x}$.

(5) $\frac{1}{x - a} + \frac{1}{x - b} = \frac{1}{x - b - c} + \frac{1}{x - a + c}$.

(6) $\frac{x - a}{x - b} + \frac{x - b}{x - c} + \frac{x - c}{x - a} = 3$.

(7) $\frac{x - 1}{x + 1} + \frac{x - 4}{x + 4} = \frac{x - 2}{x + 2} + \frac{x - 3}{x + 3}$.

(8) $\frac{a - b}{x + a - b} + \frac{b - c}{x + b - c} + \frac{c - a}{x + c - a} = 0$.

(9) $\frac{1}{1 + 2x} - \frac{2}{2 + 3x} + \frac{3}{3 + 4x} - \frac{4}{4 + 5x} = 0$.

Exercise 16

Solve the following equations—

(1) $\sqrt{(x - 7)} + \sqrt{(x + 9)} = 8$.

(2) $\sqrt{a^2 - x} + \sqrt{b^2 + x} = a + b$.

(3) $\sqrt{ax + b} + \sqrt{cx - b} = \sqrt{ax - b} + \sqrt{cx + b}$.

(4) Show that $\frac{x^2 - 6x + 5}{x^2 + 2x + 1}$ can never be less than $-\frac{1}{3}$.

(5) For what value of λ has the equation $(x^2 - 2x + 1) + \lambda(x^2 + 3x + 5) = 0$ equal roots?

(6) If the roots of the equation $ax^2 + bx + c = 0$ be in the ratio $m : n$, show that $mnb^2 = (m + n)^2 ac$.

Key to Exercise 12

(1) $\frac{7bdl^2m^4}{4a^2c^2}$. (2) $\frac{a^2yz}{2bcx^2}$. (3) $\frac{a - 2b}{a + 4b}$.

(4) $\frac{1}{(x^3 + y^3)(x^2 + y^2)}$. (5) $-(yz + zx + xy)$.

(6) $\frac{4a^2(a - x)}{(x + a)(x + 2a)(x + 3a)(x + 5a)}$.

(7) $\frac{-2(2x^2 + x - 4)}{(x^2 - 4)(4x^2 - 1)}$. (8) $(x + y + z)^2$.

(11) $\frac{8xy}{y^2 - 4x^2}$.

Key to Exercise 13

(1) $x = 6$. (2) $x = 11$. (3) $x = -13\frac{1}{2}$. (4) $x = 60$. (5) $x = 5$. (6) $x = 7$. (7) $x = 1$. (8) $x = 3$. (9) $x = 7$. (10) $x = -a$. (11) $x = 0$. (12) $x = -5{\cdot}1\dot{6}$.

M. A. L.

GEOMETRY.—XI

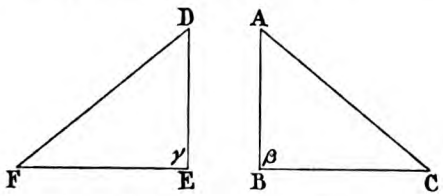
Proposition 60. Theorem

If the squares on one side of a triangle be equal to the sum of the squares on the other two sides, the angle contained by the latter is a right angle.

Let A B C be a △, such that sq. on A C = sq. on A B + sq. on B C.

It is required to prove that β is a rt. ∠.

Proof.—Let D E F be a △ having the ∠ γ a rt. ∠ and having DE = A B and E F = B C.



Then sq. on D F = sq. on DE + sq. on E F. (Prop. 59.)

= sq. on A B + sq. on B C
= sq. on A C (hypothesis).

∴ D F = A C.

In △s A B C, D E F,

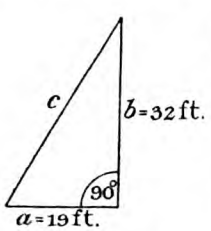
A B = D E
B C = E F
A C = D F

∴ △ A B C ≡ D E F. (Prop. 8.)

∴ β = γ = 1 rt. ∠.

(Note.—In future we shall denote the sq. on A B by A B^2 or, if a be the length of the line A B, then the sq. on A B will be denoted by a^2.)

Since the area of a square is measured by squaring the length of a side, Prop. 59 enables us to find the third side of a right angled triangle when any two of the sides are given.



Let us call the length of the hypotenuse c and that of the two sides containing the right angle a and b.

Then

$$c^2 = a^2 + b^2.$$

Examples :—

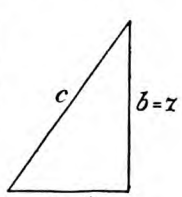
1. Given $a = 3$, $b = 4$. Find c.

$c^2 = a^2 + b^2 = 9 + 16 = 25$ ∴ $c = 5$ ft.

2. Given $c = 85$, $a = 84$. Find b.

$c^2 = a^2 + b^2$ ∴ $b^2 = c^2 - a^2 = (c + a)(c - a) = 169 \times 1 = 169$ ∴ $b = 13$

3. The foot of a ladder is 19 ft. away from the wall of a house. The top of the ladder reaches a point on the wall 32 ft. above the ground. Find the length of the ladder.



The length of the ladder is c.

$c^2 = a^2 + b^2 = (361 + 1024)$ sq. ft. = 1385 sq. ft.

∴ length of ladder = c = 37 ft. 3 in.

It is often possible to find with more or less accuracy the square root of a number by a geometrical construction.

4. To find the square root of 74.

74 may be expressed as the sum of two squares thus :

$5^2 + 7^2 = 74$. Draw a right angled triangle of which the sides a, b, containing the rt. ∠ measure 5 and 7 respectively.

Since $c^2 = a^2 + b^2 = 5^2 + 7^2$ ∴ $c^2 = 74$.

∴ $c = \sqrt{74}$. Measuring c we find $c = 8{\cdot}6$.

∴ $\sqrt{74} = 8{\cdot}6$.

It is not always possible to express a number as the sum of two squares, but it is always possible to express it as the difference of two squares.

5. Find the square root of 43.

Assume $42 = c^2 - a^2$.

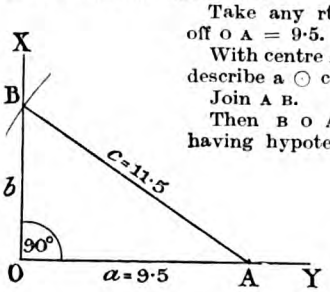
Then $42 = 2 \times 21 = (c + a)(c - a)$.

Assume $c + a = 21$ and $c - a = 2$.

Solving these equations $c = 11{\cdot}5$, $a = 9.5$.

Then $42 = (11{\cdot}5)^2 - (9{\cdot}5)^2$.

Draw a right angled triangle with the hypotenuse = 11·5 and one side = 9·5.



Take any rt. ∠ x o y. Mark off o A = 9·5.

With centre A and radius = 11·5 describe a ○ cutting o x at B.

Join A B.

Then B o A is a rt. ∠d △ having hypotenuse $c = 11{\cdot}5$ and one side $a = 9{\cdot}5$.

Thus $b^2 = c^2 - a^2 = 42$.

∴ $b = \sqrt{42}$.

Measuring b we find it = 6·5.

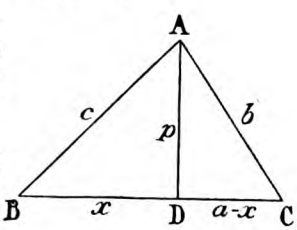
Any convenient unit of measurement may be taken.

Additional Theorem D.

If a, b, c denote the sides of a triangle, and $2s = a + b + c$, the area of the triangle = $\sqrt{s(s-a)(s-b)(s-c)}$.

Let A B C be the △.

Draw A D ⊥r to B C, and let B D = x so that C D = $a - x$; let A D = p.



$c^2 = p^2 + x^2$ (Prop. 59.) ∴ $p^2 = c^2 - x^2$

again $b^2 = p^2 + (a - x)^2$ (Prop. 59.)

∴ $p^2 = b^2 - (a - x)^2$

∴ $c^2 - x^2 = b^2 - (a - x)^2$

whence $x = \dfrac{c^2 + a^2 - b^2}{2a}$

Hence $p^2 = c^2 - x^2 = c^2 - \dfrac{(c^2 + a^2 - b^2)^2}{2a}$

$$= \left(c + \frac{c^2 + a^2 - b^2}{2a}\right)\left(c - \frac{c^2 + a^2 - b^2}{2a}\right)$$

$$= \left[\frac{(c + a)^2 - b^2}{2a}\right]\left[\frac{b^2 - (c - a)^2}{2a}\right]$$

$$= \frac{(c + a + b)(c + a - b)(b + c - a)(b - c + a)}{4a^2}$$

Now $c + a + b = 2s$ ∴ $c + a - b = 2(s - b)$

and $b + c - a = 2(s - a)$

and $b - c + a = 2(s - c)$.

$$\therefore p^2 = \frac{4s(s-a)(s-b)(s-c)}{a^2}$$

$$\therefore \frac{ap}{2} = \sqrt{s(s-a)(s-b)(s-c)}.$$

But the area of $\triangle ABC = \frac{ap}{2}$

$\therefore$ the area of the $\triangle = \sqrt{s(s-a)(s-b)(s-c)}$.

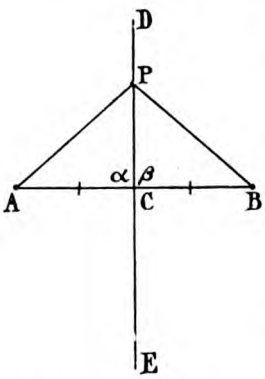
Loci

Definition.—If a point may move, but in so doing must satisfy a certain condition, the path which it traces out is called its **locus.** Thus we may say that the locus of a point which satisfies a given condition is the line (straight or curved) or set of lines upon which it is necessary and sufficient that the point should lie in order to satisfy the given condition.

For instance, the locus of points which all lie at a distance of 1 inch from a given point A, is the circumference of a ○ of radius 1 inch having A as centre.

Example : —

1. *The locus of a point equidistant from two given points is the straight line which bisects at right angles the line joining the given points.*



Let A and B be the two given pts.

Let C be the mid. pt. of A B and let D C E be ⊥r to A B.

It is required to prove that all points on D E are equidistant from A and B.

Proof.—Take any pt. P in D E. Join P A, P B.

In $\triangle$s P C A, P C B P C is com.

C A = C B (constr.).
$\alpha = \beta$ (rt. ∠s.) $\therefore \triangle$P C A ≡ $\triangle$ P C B (Prop. 5)

$\therefore$ P A = P B.

Similarly it may be shown that every other point on D E, however far it may be produced in either direction, is equidistant from A and B.

The student should prove for himself the truth of the following :

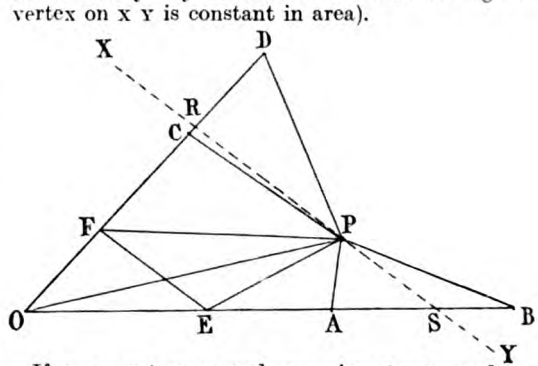
2. *The locus of a point which is equidistant from a pair of intersecting straight lines is the bisectors of the angles between the straight lines.*

3. *The locus of a point which is at a given distance from a given straight line, on one side of it, is a straight line drawn parallel to the given straight line through any point which lies at the given distance from the straight line.*

4. *The locus of a point which is at a given distance from a given straight line, consists of two lines, each parallel to the given straight line one on each side of the line.*

5. *If A B, C D be two straight lines given in position and magnitude, and if a point P moves so that the sum of the areas of the triangles A B P, C D P is constant, the locus of P is a straight line.*

Let A B, C D intersect at O.
Cut off O E = A B, and O F = C D.
Join O P, E P, F P, E F.
$\triangle$ A P B = $\triangle$ O P E in area
$\triangle$ C P D = $\triangle$ O P F in area } (Prop. 35, Cor. 3.)
$\therefore$ sum of $\triangle$s O P E, O P F is const.
$\therefore$ area of quad. O E P F is const.
But the $\triangle$ O E F is obviously constant.
$\therefore$ the area of $\triangle$ E F P is constant.
$\therefore$ the locus of P is the str. line X Y ∥ to E F (since clearly any $\triangle$ on base F E and having its vertex on X Y is constant in area).



If X Y cut O D and O B in pts. R and S, then it is clear that when P coincides with R, the area of $\triangle$ C P D vanishes ; and when P passes to the other side of C D, say to the pt. X, the area of the $\triangle$ C P D must be regarded as negative, i.e. it must be subtracted from the area of $\triangle$ A P B to obtain the given area. Similar remarks apply to the $\triangle$ A P B and the line A B.

The student should prove the following corollary.

If A B C D be a quadrilateral, and if P be a point, so that the sum of the areas of $\triangle$s A B P, C D P is half the area of the quadrilateral, the locus of P is a straight line passing through the middle points of the diagonals of the quadrilateral.

Exercise 14

1. Draw the locus of a point which moves between the arms of a right angle X O Y in such a way that its distance from O X is always greater than its distance O Y by 1·5 inches.

2. Take two points A and B at a distance of ·8 inch. Find the locus of a point P which moves so that the differences of the distances of P from A and B is ·4 inch.

3. Draw two straight lines O X, O Y at right angles. Find by the method of intersecting loci a point P within angle X O Y whose distance from O is 2 inches, and the product of whose distances from O X and O Y is 18 inches.

(Squared paper may be used for the above.)

4. The hypotenuse B C of a right-angled triangle A B C is fixed. What is the locus of A ?

5. A B C is a triangle. In A C a point E is taken and in A B a point F. The parallelogram A E H F is completed, and B E, C F are joined : prove that if E, F move along the sides A C, A B of the triangle, in such a way that the sum of the areas of triangles A E B, A F C remains always the same, H moves along a straight line parallel to B C.

6. From fixed points A B on the circumference of a circle, straight lines are drawn to cut the circle again at C and D ; show that the locus of the middle point of C D is a concentric circle (i.e. a circle which has the same centre as the original circle). M. A. L.

Continued from page 174

ART AND MUSIC:

Contributors:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).

DRAWING.—IX

It is now proposed, before going to that important branch of drawing, shading from models, to deal a little further with the effect of sunlight. If you turn to Figs. 45, 46, and 47 you will see the shadows thrown by a pillar when the sun is in three different positions. In Fig. 45 the sun is parallel with the picture plane and on the right of the station point. Thus it casts a shadow parallel with the horizontal line and, of course, the picture plane.

If you look at Fig. 46 you will notice that the sun is behind the station point or the observer, so that the shadow is thrown along retiring lines. In Fig. 47 the sun is before the observer, behind the picture, so that the shadow comes towards you.

Sunlight and Shade

Now the parallel position of the sun serves as a very useful object lesson in geometry, which it will be useful to the student to notice here. Fig. 48 represents two walls which make a right angle. The back wall A is parallel to the picture plane, whilst the other, B, is perpendicular to the picture plane. The rays of the sun are falling at an angle of 45°. Draw the dotted line *a b*, and with another dotted line, which ends at *c* on the horizontal line, make an angle of 45°. This line *b c* is now parallel with *d e* and *f g* and all inclined lines of shadow. We should now set out to show that the edges of the shadows of objects in a horizontal position have the same vanishing point as the lines of the object itself in parallel perspective, *h g*, for example, is the edge of the shadow of the wall B. Both this edge of shadow and the wall are directed towards the point of sight. So is the top of the doorway, and the edge of the shadow of the lintel *e i* is also directed towards the P.S. The extent of the shadow depends on the inclination of the sun's rays, and also, of course, on the height of the building.

It is worth noticing that when the horizontal shadow of a perpendicular object is equal in length to the height of the object, the sun's rays are inclined at an angle of 45°. If you draw a triangle, with a horizontal line of two inches and a perpendicular line of two inches, then the line which joins these two, together with the horizontal line, forms an angle of 45°. All the sun's rays below the level of our two inch perpendicular wall are obliterated or rather obstructed by that wall, therefore the side of the wall away from the sun is in shadow, and there will be a shadow along the ground until that point is reached, which in this case is at a distance of two inches from the bottom of the wall, where the sun's rays slant down over the top of the wall and, finding nothing in their way, strike and illumine the ground.

When you draw a shadow which lies horizontally on the ground, it is a good plan to draw the lines that compose it (we are not for the moment discussing the use of stumping chalk) in a horizontal direction also. In this way the retiring shadows will *look* horizontal. Whereas, if you draw the lines in the direction of the vanishing point to which the shadow goes back, the shadow would then look as though it slanted to the horizon, like a roof of a house. Cast shadows on upright planes—a wall, for example—are best rendered by upright or perpendicular lines.

Shading from Models

To shade successfully with ordinary pencil lines requires the utmost patience and very considerable practice. The great thing is to make experiments, and try again and again until you have perfected them. Shadows composed of straight lines are comparatively easy. It is with curved lines that your real troubles begin: for the curves must be true. Suppose that you are drawing a spherical object such as a ball. If the shading is to be at all right, the curved lines must be equi-distant and regular, and so must those be which cross them where the shadow requires to be darker.

The question of shading solid objects naturally directs our attention to the study of models. You will have learnt quite enough now to discard copies for the time being, and to devote yourself to the drawing of the actual object, which is naturally of greater value to you as a draughtsman. Here, as always, it is necessary to begin with simple forms and to go on with the more elaborate objects later. After all, in whatever you are drawing, simple forms are always cropping up in real objects. The cube, the cylinder, the hexagonal, prism, are, every one, the groundwork of familiar things.

You should make a beginning with the *cube*. Set this before you on a piece of brown paper, with another piece behind it, pinned to the wall to serve as a background. So arrange the object that the

light comes from the right and from above. It will now naturally follow that the top of the cube will be quite bright, and its darkest face will be that which rises at right angles to the cast shadow. (Figs. 49 and 50.)

First of all draw your cube with the charcoal stick. Be sure that the lines are very light and that you take pains to make them accurate. The perspective is simple, but requires diligent care. Place the object before you as it is in the fig., and notice the retiring lines of the sides. The objection, by the way, to using an ordinary pencil for this outlining, is that lines drawn with it come out white when you have put in the shading.

The next step is to draw the cast shadow. You should observe that this is darker than the background, and that the intensity of tone diminishes as it recedes from the object.

Next you should shade the two faces. These are different in the depth of tone. Each should be of an even tint, of the same depth as the lightest part of each.

On each face you will now see there is a certain amount of gradation. This is caused partly by contrast, partly by the light reflected from the ground plane. So having got the light, even tint over all the surface of your two faces, proceed to shade over. Take particular care not to let the darker parts become too dark. When shading over, begin with the darkest part and gradually diminish the depth or intensity of the shade until the *extra shading* is lost in the tone that you laid on originally. Notice, too, that the cast shadow is darkest near the object and gradually fades. Be careful to represent this actually with your stump. The top of the cube is not quite white, though it may be thought so when seen in contrast to the shaded sides. Put on the merest suggestion of tone at that part farthest from you, bringing it to a totally shadeless surface where the contrast of the two faces makes the brightness most apparent. Now darken up the background where it touches the two lines of the top face. (Figs. 49, 50, 55, 56).

Once you are master of the cube, the various prisms—hexagonal, pentagonal and so on—should give but little trouble. Take an hexagonal prism as your model, and arrange it as you did the cube. Draw the outline with charcoal and the course of the shadow too. Shade in the ground, the background and the shadow itself, next put on the even tones of the two dark faces. Let the gradation work from the top right-hand corner of each face, as in the drawing of the cube. The lightest face, which is next to the light, is similarly graded, but the tone is very light indeed, falling off almost to nothing. Now make the cast shadow darker, making quite sure that its edges are clear. The darkening of the background will throw up the whole object in relief, particularly about the top of the object and down its lightest side. Remember to

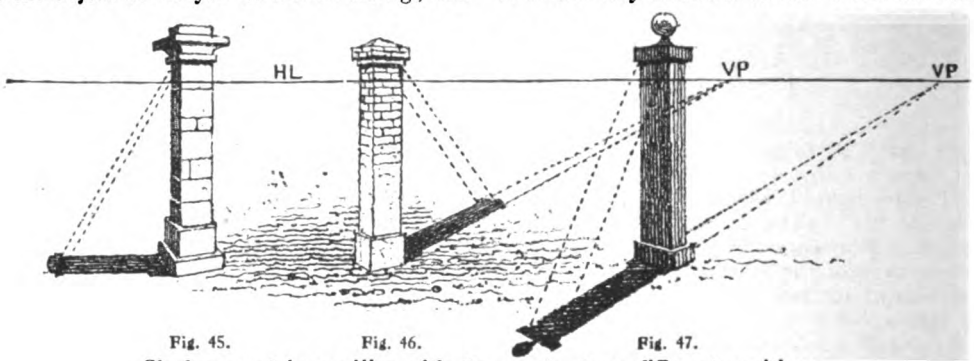


Fig. 45. Fig. 46. Fig. 47.

Shadows cast by a pillar with the sun in three different positions.

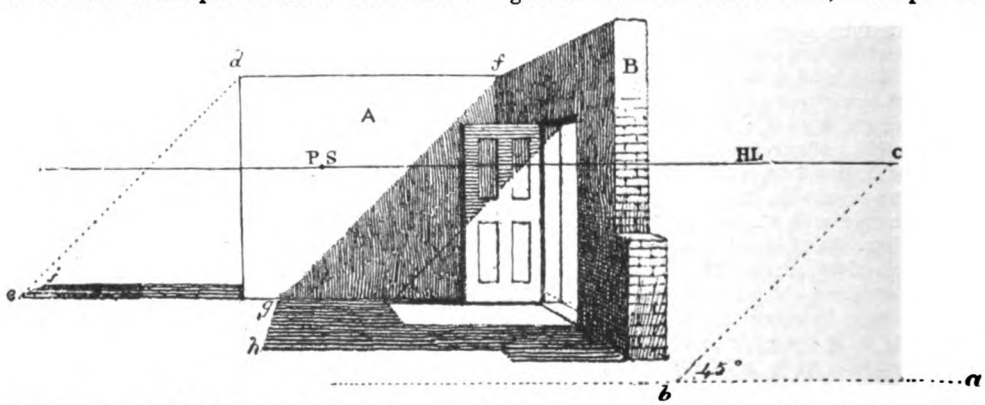


Fig. 48.—When the horizontal shadow of a perpendicular object is equal in length to the length of the object, the sun's rays are inclined at an angle of 45°.

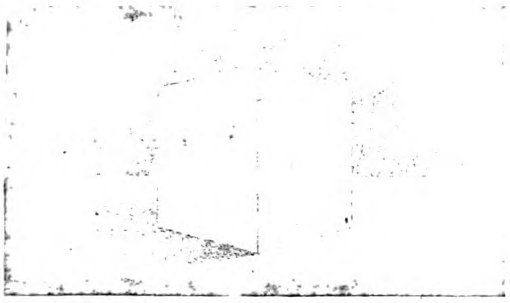


Fig. 49.

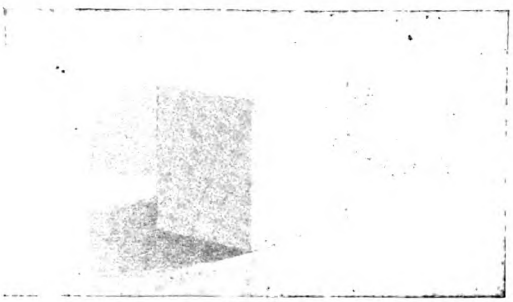


Fig. 50.

observe that the extreme left of the last perpendicular face is not the darkest part, neither is the extreme right of the right-hand face the lightest.

In these experimental drawings, it is just as well, for the sake of practical accuracy, to make the whole outline visible, but in all good work—"finished" work, that is—the lines enclosing an object should be indicated, as is really the case when you observe an actual object, by the coincidence of two tones, one of which is darker than the other.

The next exercise, which it is important that you should study, is the *cylinder*. This, in one dimension, is a circular object; but it may be regarded roughly speaking as an object with an infinite number of sides—a prism, in fact. For the practical purpose of this exercise, however, you may regard the cylinder as a prism with, say, twenty faces, ten of which are visible as you look at it.

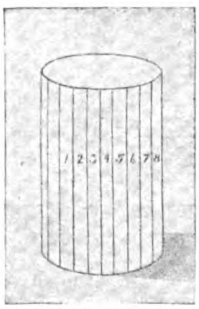


Fig. 51.

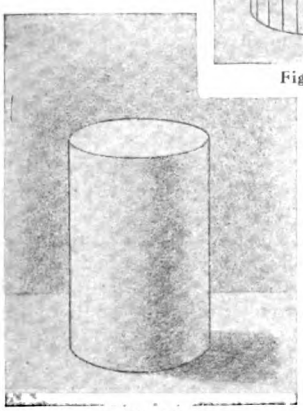


Fig. 52.

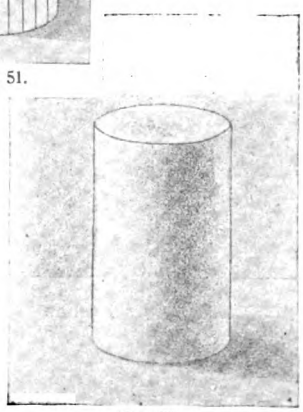


Fig. 53

Do not put these in when drawing from your model, but imagine them. (Figs. 51, 52, 53 and 54.)

First of all, put in the background and the cast shadow in an even tone. Next put on the shade or broad shadow on the cylinder, which you have already drawn as in the other exercises with the charcoal. Spread out the shade gradually towards the right-hand side. Your *high light* is on the left. Shade towards it gradually with a very light tone. Remember that, as in the case of the prism, the high light is a little distance from the edge of the object, so shade that edge very slightly to meet the high light. The top has its high light towards the front, so shade from the back accordingly; also notice that where the edges of the shades on the sides meet the top they look a trifle darker than elsewhere. To understand this, be sure you study the actual model as well as the diagram.

Fig. 54.

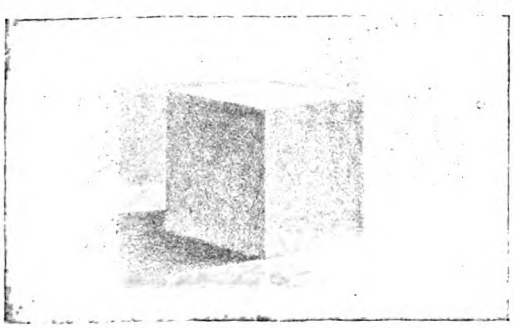


Fig. 55.

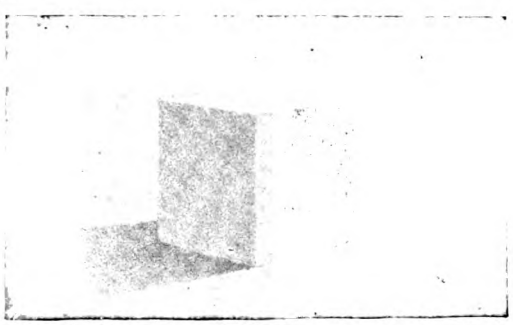


Fig. 56.

Remember, in drawing these exercises in solid objects, to sit at right-angles to the rays of light shining on to the models. But it is an excellent thing to go elsewhere and draw these models from various different station points. To take an example, if you go to the left of the standing cylinder, it will be the very edge of all that shows darkest, and at the same time the reflected light will have disappeared. It will be behind the model. But, in order to grasp your subject scientifically, you should know where lights are, even though you can't see them.

Another point to remember is that the brightness and intensity of high lights on any object depends on two things: the amount of polish on the surface of your model, and the nearness of other objects calculated to convey or reflect light. The leg of a table, or a flower-vase, or a hundred and one objects that you can think of, will have a far more intense lightness than the rough trunk of a tree, which will scarcely be said to have a high light at all.

J. G. B. L.

BOOKPLATES

One of the most delightful occupations for the artist is the making of bookplates. It is frequently also a profitable side issue for the adept draughtsman. Speaking of artists generally it will be sufficient to deal only with the designing of bookplates but very often the processes of reproduction are the artist's business as well.

These may be enumerated. Bookplates may be etched, engraved, lithographed, cut in wood or reproduced by the cheap, but not always nasty, mechanical photographic system. The first four of these are usually undertaken by the artist himself, and of these four etching undoubtedly comes first for beauty of appearance, delicacy of line, and as a purely individual interpretation of the artist's method. These processes, including very often the actual printing, are the work of artist-craftsmen.

The designing of a bookplate, whether it be rough or finished, is within the sphere of anybody who can draw. Bookplates, or "*ex libris*" as they have grown to be called sometimes, serve two purposes—useful and ornamental. A well designed plate embellishes the book in which it is placed and is a convenient manner of giving its owner's name. With regard to the design, we may use a twofold division again: the designs are either heraldic or purely fanciful. The most common form of bookplate is that which gives the owner's coat of arms and his name. Sometimes the heraldic device is worked into a little picture.

This is most effectively done in the etched plates of such masters as Mr. Frank Brangwyn and Mr. D. Y. Cameron. Heraldry is in itself decorative, but whether the design is to be purely heraldic, as in the case of Mr. G. W. Eve's etched plates, is for the taste of the owner to decide. Personally I prefer the simple heraldic design for those who have the established right to bear arms. Mere pictures chosen because the owner likes the work of the artist and having nothing specially in harmony with a collection of books may just as well be framed and put on the wall.

One of the most successful designers for photographic reproduction was the late Aubrey Beardsley, whose line work specially lent itself to this form of reproduction.

A hundred years ago or so the generality of bookplates were engraved and were the simplest possible representation of the owner's arms with his name beneath them. There was nothing in the least decorative about them, as a rule, and they merely served the useful purpose of memorising the ownership of the book in which they were put. Mr. Frank Newbolt, writing in the "Studio" in December, 1909, says: "The invention of gunpowder has much to answer for. Until the fourteenth century heraldry gave the only clue by which a man, prince, baron, knight or servant could be distinguished in the field, and an intimate acquaintance with the principal blazons, marks and terms was much commoner than an elementary knowledge of letters."

Heraldic Designs

Heraldry requires considerable study itself, but it is much simpler than many suppose, and should be cultivated by any artist who wishes to design bookplates.

Monograms and initial plates may also be used for books, and these if they are to be effective require artistic and original treatment.

In any design for a bookplate the artist should seek to express something of the individual taste of the owner of the books. Sometimes the interior of a favourite room is given, sometimes, more generally, a pile of books with a figure bending over them, sometimes a ship, sometimes merely a decorative design round the tablet on which the names are given. The aesthetic

lady reading a book is an idea which has been worked almost to death. Mr. R. Anning Bell, two of whose plates are reproduced on this page, has on several occasions made use of the figures of *Prose* and *Poetry*—an excellent example of appropriate symbolism.

Bookplates should be small, say, four inches high by two and a half inches broad. Three by four inches or two by three inches are good sizes; but they may well be much smaller. The general plan should not be too fine in execution, nor the lines niggling. Bold free work, broad effects of light and shade or even black and white are the most

The young bookplate designer should beware of the æsthetic lady reading a book. The idea has been too frequently employed by master-craftsmen—

suitable. The design may be in a border which is oval, circular, oblong or square. The oblong or oval are preferable, as more suited to the shape of the book they embellish.

Note.—The two bookplates shown on this page are reproduced by kind permission of the artist, Mr. R. Anning Bell, and the owners.

The history of bookplates in England is of great interest. For it is nothing less than the history of the numerous styles of decorative art which have prevailed from pre-Restoration days.

We first meet with the *early armorial*, in which the design is mainly heraldic, as exemplified in the bookplate presented

—The distinctive figures of *Prose* and *Poetry*, of which Mr. R. Anning Bell has also made effective use, deserve attention.

to the University of Cambridge in 1574, by Sir Nicholas Bacon—the earliest English bookplate on record. The *Jacobean* style, which covers that of the Queen Anne and the Georges period, is a heavy massive kind of carved oak decoration.

Later, the decoration tended to become allegorical or symbolic, expressing something of the personality or the *Weltanschauung* of the owner of the books. And bookplate designing soon became a minor branch of a higher art.

It is only from about 1875 that a value other than personal has been attached to bookplates, and that a literature of the subject has been written. Collectors formed themselves into societies, and in London they started the *Journal of the Ex Libris Society*.

J. G. B. L.

Continued from page 184.

BUSINESS AND COMMERCE:

Contributors **:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).**

COMMERCIAL TRAINING.—XI

In these days no business man can afford to be without a banking account, not merely for the safeguarding of his cash and securities, but also for the transaction of his many financial dealings connected not only with the paying-out of money, but also with receipts.

In our last lesson we dealt with the opening of a banking account and discussed the routine of drawing cheques, whilst the importance of the endorsement on an " Order " cheque was touched upon. Certainly too much care cannot be bestowed upon the endorsing of cheques before paying them into a bank, if only to avoid the annoyance of having drafts returned for the rectification of their endorsement.

Endorsing Cheques

In every case where a cheque is made payable to an individual the endorsement should exactly correspond with the title on the face of the draft. Your name may be John William Ewart, and you may sign your own cheques John W. Ewart, but if you receive a cheque drawn to the Order of J. William Ewart, you should endorse it on the back precisely in that way.

If you receive a draft made out with the wrong initials altogether, such as Percy K. Ewart or E. W. Ewart, your correct endorsement would be Percy K. Ewart or E. W. Ewart, but underneath you should write your ordinary signature, John W. Ewart.

A cheque drawn in favour of a firm requires to be endorsed with the name of the firm, and is generally countersigned by one of the partners. Thus a draft " Pay to Messrs. Jones & Sons " would be endorsed Jones & Sons, J. W. Jones, and the words " Jones & Sons " are in this case usually printed with a rubber stamp above the written signature J. W. Jones. Where limited liability companies are concerned there are usually one or more persons on the board of directors or on the staff authorised to sign endorsements, but in every case it must be stated in what capacity the endorser acts. Thus, a cheque made payable to Messrs. Dawson & Fry, Ltd., might be endorsed in either of the following ways :

Dawson & Fry, Ltd.,
Aubrey Dawson, Director;

Dawson & Fry, Ltd.,
Charles Fitz, Secretary;

and so on, according to the position occupied by the person duly authorised to sign the endorsement to cheques.

A cheque made payable to Mrs. Mary Jones should be endorsed Mary Jones, but had the draft been made out to Mrs. John Jones, the lady would endorse Mary Jones, wife of John Jones. A cheque drawn in favour of plain Mr. Jones or Mrs. Jones would be endorsed John Jones or Mary Jones, as the case might be, and naturally the payee should make no attempt to introduce his own initials into the body of the draft or to tamper with its front in any way.

Drawing Cheques

If at any time it becomes necessary when drawing a cheque to make an alteration or correction, the change should be covered by the signature of the drawer and *not* merely by his initials. The great majority of banks refuse to pass a cheque with alterations unless the alterations are actually countersigned in full.

A cheque that has been drawn but not presented for payment for some time is known in business circles as a " stale cheque." The rules concerning its treatment vary slightly according to the exact circumstances. Some banks will not honour a cheque that is more than one year out of date without first making enquiry of the drawer; other banks fix the limit of time at six months,

and so on. Then again, many firms actually state upon their cheques that if the draft is not presented within one month or two months, as the case may be, the document will not be honoured.

A word concerning Pass Books. On opening an account at a bank, a customer will receive a pass book. This book, so long as the account remains in operation, will show precisely the transactions from day to day, the balances at each of the quarters of the year, and a full statement of all the moneys that have passed inwards or outwards.

From time to time customers send for their pass books in order to check them and to ascertain precisely how the account stands, but it is desirable that the book should remain in the custody of the bank for, at all events, a portion of each month.

It will be obvious that too much care cannot be expended upon the careful checking of one's pass book at frequent intervals.

Should any discrepancy appear, the matter should be taken up at once with the bank, and no pains spared until the account has been corrected.

In cases where charges are made by banks for keeping accounts, these matters appear usually as the last item on the paying-out side at the close of the quarter when the balance is struck and particulars of loans are inserted in the same way. March 31st, June 30th, September 30th, and December 31st are the days when banks strike their

HOW THE GREAT WAR AFFECTED WAGES.

An interesting comparison between the proportionate increase of wages in Britain which occurred in various trades between 1914 and 1920 (the period of the War and Armistice). The greatest increase it will be noticed has been gained by the so-called Triple Alliance (miners, transport workers, and railwaymen).

balances, and the final entries appear in the pass book on these lines :

When an account is clear and there is a remunerative balance :

		Balance .	97	12	7
£1,265	6	6	£1,265	6	6

When an unremunerative balance has been maintained :

	Bank Charges .		0	10	6
	Balance . .		10	8	10
£216	12	6	£216	12	6

It will therefore be seen that though it is most important always to check one's pass book at frequent intervals, varying according to the amount of business transacted, it is doubly so to ascertain clearly how one's account stands at the close of every quarter of the year and to compare one's own figures of account with those kept by the bank and shown in the pass book.

What generally occurs in the case of an overdrawn account, unless an express arrangement has been made with the bank manager in the meantime, is that a reminder comes along very promptly from the bank by post acquainting the customer with the fact; and naturally no further cheques should be drawn upon the account until the matter has been adjusted, either by more money being paid in or by an arrangement being made with the bank permitting the overdraft to stand upon terms to be agreed.

A. B.

CHOOSING A CAREER.—XII

APART from Government work at home, there exist in our Colonies and Dependencies across the Seas what may be termed local civil services; and in a great many of the departments vacancies as they occur are filled from the Mother Country. In fact, in the case of the more important services, the examination of candidates is conducted by the *Civil Service Commission, Burlington Gardens, London, W.*1.

Government Services Abroad.—One of the finest branches of Crown employment that a young man may enter is the Civil Service of India. Vacancies are filled by means of an annual examination, particulars of which are obtainable from the Secretary of the Commission. The fee is £6 and the examination itself is practically identical with that set for candidates for First Division Clerkships in the Home Service, so that the type of young man most likely to succeed is the one who has enjoyed a public school education and afterwards proceeded to a University.

After the examination those who are successful are required to serve a year on probation at a College at home before taking up their residence in India, and during this time they are expected to pass official tests in horsemanship and also acquire some knowledge of the Indian Penal Code, Indian History and the local language of the Province to which they are ultimately going.

The prospects of speedy advancement in the Indian Civil Service are considerable. Holidays to the extent of about one-fourth part of active service are granted, whilst there is a pension on retirement for those who complete sufficient service.

In the **India Forest Service** there are also good openings for candidates possessing the necessary qualifications. It is essential, however, that applicants shall be prepared to give two or three years to acquiring special knowledge and training for their work and they must also have passed with honours a public examination in Science at one of the Universities.

Those who wish to become candidates for this Service should make application on forms to be obtained for the purpose from the *Secretary, Revenue Department, India Office, London, S.W.*1, and it goes without saying that a very searching medical examination has to be faced.

Appointments in the **India Police Service,** as well as in certain **Colonial Police Services,** are made on the result of open competitive examinations conducted in London.

The Colonial Services that for the purposes of this examination are joined with the Service of India are those of Ceylon, Hong Kong, the Federated Malay States, and the Straits Settlements. Successful candidates as soon as the result of the examination is declared, are asked to decide to which particular service they prefer to be appointed, and, in the case of India, to which Province.

Also in the India Service, there are to be obtained appointments in the Public Works Department and the State Railways, the former dealing mainly with roads and irrigation. Generally, the vacancies are for Assistant Engineers, and candidates are chosen by a Selection Committee.

For young men who have passed through a period of training in medicine, the **Indian Medical Service** offers considerable attractions, and complete details of the latest regulations are obtainable from the *Military*

*Secretary, India Office, London, S.W.*1. Candidates must possess the qualifications of a doctor and surgeon in Great Britain and Ireland.

India Customs and Finance Departments include a number of appointments that are made at home with the aid of a Selection Committee. Candidates must possess University degrees with honours. In the case of an **Eastern Cadetship,** the examination is very much the same as the Class 1 Clerkships test in the Home Civil Service and a University education imperative.

There are certain Administrative Appointments in East and West Africa, and also in Rhodesia, which include District Commissionerships, Residentships and so on. To obtain information as to these appointments inquiry should be directed to the *Secretary of State for the Colonies, Whitehall, London, S.W.*1.

Applications should be made through the Appointments Committees respectively of the Universities of Oxford, Cambridge or London to secure an opening in the Civil Services of Egypt and of the Soudan.

Interpreterships, vice-consulships and consulships come under the jurisdiction of the Foreign Office, from which the latest details are obtainable. For the actual consular service University men are usually selected or those who have qualified for the Bar. In some cases young men who have had good business training are chosen, and there is a tendency to widen the sources of recruiting. The examinations are conducted by the Civil Service Commission.

In addition to the important police appointments mentioned above there are also Police Services under the Crown in Jamaica, British Guiana and Trinidad. Particulars of the latest regulations concerning these appointments may be obtained by writing to the *Under-Secretary of State, Colonial Office, London, S.W.*1.

So much for the Government appointments abroad that are usually filled by means of open competition. There are, however, what may be termed **Nomination Appointments.** These include clerks at Gibraltar in the Colonial Service, also a local division of the Ceylon Civil Service. In these instances candidates must possess the nomination of the Governors of the respective Possessions.

The Civil Services of our various Colonies, Dependencies and Overseas Dominions, with the exception of the appointments specified above, are entirely in the hands of the various local governments. In Canada, for example, there are the special local examinations of the Canadian Government, and for some of the appointments a three years' residence is required. The latest regulations may be ascertained by writing to the *Secretary, Civil Service Commission, Ottawa, Canada.*

In the Commonwealth of Australia, these matters are in the hands of the *Commonwealth Public Service Commissioner, Melbourne,* and it is much the same in New Zealand, but no one should emigrate from the Mother Country with the idea of entering these Civil Services without some very specific reason.

Turning now to the question of police in our Overseas Dominions ; that is, men who serve in the ranks, in contradistinction to the higher appointments referred to above in the India Police Service ; there are many splendid forces of police in our Colonies and some of them are recruited largely from young men lately emigrated from the Mother Country. Further, in some instances special encouragement is given to those who served in the Great War.

There is, for example, that splendid body of men known as the **Royal North-West Mounted Police,** which numbers nearly eight hundred officers and men, and polices an enormous area of Canada. To join this force applications may be made only in Canada, to the *Adjutant at Regina, Saskatchewan ;* but preliminary inquiries may be directed to the *High Commissioner for Canada,* 17 *Victoria Street, London.*

Many of the recruits are obtained from Great Britain and Ireland, but passage and other expenses of the journey must be paid by the men themselves. Applicants must be British subjects, able to ride well and willing to engage for three years. Commissions are obtainable by promotion from the ranks.

The Cape Mounted Riflemen ; the Cape Mounted Police ; the District Mounted Police of Cape Colony ; the Natal Police ; the Transvaal Police ; and the Orange River Colony Police all form part of the **Police Force of the Union of South Africa.** Only British subjects are engaged, and application for particulars as to physical standards, pay and so on, should be made to the Commissioner of the South African Police at Pretoria. Intending candidates in the Old Country may, however, first communicate with the *High Commissioner of the Union of South Africa,* 32 *Victoria Street, London.*

Candidates for police appointments in Uganda and in East Africa should apply to the *Colonial Office* in London. A. C. M.

BOOK-KEEPING.—IX

Bills of Exchange are extensively used in commercial transactions, especially in connection with the manufacturing and merchanting of goods on a large scale, and also in Overseas trading.

Bills of Exchange

One of their objects is to enable traders to take advantage of capital advanced to them by Banks or discount houses. Suppose a manufacturer is, in March, making cloth for the following winter's wear. He is anxious to secure orders from a merchant, but as the latter will not be able to sell the cloth for some time after it is delivered to him, he is naturally not anxious to purchase and pay for goods which he will have to keep in stock for a long period. As an inducement to him to purchase, the manufacturer undertakes to accept an order and deliver the goods on the understanding that payment is to be made, say, three months after delivery.

Under ordinary circumstances this would result in the manufacturer having to wait three months for his money. If he happened to be not overburdened with capital it might seriously cripple his resources. It is possible, however, for him to draw a Bill on the merchant, payable at three months' date. This the merchant would accept. The completed Bill would then be taken by the manufacturer to his Bank, which would credit him with the value, less a charge for the use of the money for three months. The net result is that the manufacturer sells his cloth and gets payment; the merchant receives the goods, for which he is allowed to pay in three months' time, the Bank in the meantime advancing the money.

The law in regard to Bills of Exchange is set out in the Bills of Exchange Act, 1882. The legal definition of a Bill as given therein is as follows: "A Bill of Exchange is an unconditional order in writing, signed by the person giving it, requiring the person to whom it is addressed to pay on demand or at a fixed or determinable future time a sum certain in money to or to the order of a specified person or bearer."

On this page is shown an ordinary inland Bill of Exchange.

It is an unconditional order signed by James Simpson, requiring Williams & Bartlett to pay in three months' time a specified sum of money (£610) to his order. The **parties** to this Bill are:—

Drawer: James Simpson.

Drawees: Williams & Bartlett. They are the persons on whom the Bill is drawn, and will ultimately have to pay the money.

Payee: James Simpson, the person to whom the money will ultimately be paid.

No. 182. *Manchester,*

£610 0 0 *21st January,* 1920.

Three months after date pay to my order the sum of Six Hundred and Ten Pounds, value received.

Impressed Stamp, 7s.

Messrs. Williams and Bartlett,
Gracechurch Street,
London, E.C.

JAMES SIMPSON.

A Common Form of Inland Bill of Exchange.

When the above Bill is drawn by James Simpson it will be forwarded by him to the drawees with a request that they will "accept" it and afterwards return it to him. By "accepting" the Bill the acceptors indicate their readiness to comply with its terms. This is done by writing across its face the following:—

Accepted, payable at the City and County Bank, Gracechurch Street, London. Williams and Bartlett.

The Bill will then be returned to the drawer.

Before being accepted a Bill is generally referred to as a **draft.** After it has been accepted it becomes an **acceptance.** In the

specimen given on p. 246, Messrs. Williams & Bartlett are the acceptors, and they would refer to the Bill as their acceptance.

The Bill has many advantages:—

(1) It is a legal acknowledgment of indebtedness with a promise to pay.
(2) It is a negotiable instrument which may be transferred from one person to another.
(3) It is a document which can be discounted, i.e. sold for cash, at any time, but not at its face value.

When a Bill is accepted without having any comment written upon it which would vary its terms, the acceptance is said to be a **general** (or **unqualified**) acceptance.

Where an acceptance is made which varies the terms, it is said to be **qualified**. On this page is a table showing some of the ways in which an acceptance may be qualified.

A Bill may also be accepted on behalf of **one** of the drawees but not **both**.

When the name of a Bank is given in the acceptance it is necessary for the Bill to be presented at that Bank for payment, and the Bill is said to be **domiciled** there.

The drawer of a Bill is at liberty to refuse to take a qualified acceptance.

The Bill set out on the previous page is dated the 21st January, and as it is payable in three months from that date it would nominally become due on the 21st April. Following an old custom which was legalised in the Bills of Exchange Act, 1882, three days beyond the specified date are allowed for payment. These days are called **days of grace**, and the Bill in question would become due on the 24th April.

A Bill payable **on demand** or **on presentation** is not subject to days of grace, and the extension of three days can also be avoided by writing the word "fixed" after the date thus:—"On the 21st April fixed," or by inserting in the Bill the phrase "without days of grace."

When the last day of grace falls on a Sunday, Christmas Day, Good Friday, or a day appointed by Royal Proclamation as a public fast or thanksgiving day, the Bill is due and

Kind of Qualification.	*Example.*
Conditional.	Accepted on condition that the goods are delivered by a specified date.
Partial.	A Bill for £700 accepted for £500 only.
Local.	Accepted payable at a specified Bank and *there only*.
Qualified as to time.	A Bill payable at three months accepted for four months.

Kind of Endorsement.	*Example.*	*Effect.*
In blank.	James Smith.	Specifies no endorsee, and thus makes the Bill payable to bearer.
Special.	Pay William Brown or order James Smith.	Shows that the Bill is now payable to William Brown or his order.
Restrictive.	Pay William Brown only James Smith.	Prohibits any further negotiation of the Bill.
Sans recours.	James Smith, sans recours (or—without recourse to me).	"Sans recours" means "without recourse to me," and signifies that the person endorses the Bill without accepting liability. This form of endorsement is usually adopted by an agent when acting for his principal.

payable on the preceding business day. When the last day of grace is a Sunday, and the previous day is a Bank Holiday, the Bill is due on the Monday.

A month means a calendar month, so that a Bill at three months drawn on 31st March will be due on the 30th June, plus three days of grace, i.e. 3rd July.

A Bill at one month drawn on the 30th January will in the same way become due on the last day of February, plus three days of grace, i.e. 3rd March.

Bills of Exchange are subject to stamp duty, the stamp being an impressed one. The table below gives the duty payable.

Endorsement Safeguards

It has already been pointed out that a Bill of Exchange is a negotiable instrument. If a Bill is made payable to a specified person or bearer, it will not require to be endorsed, but if made payable to a specified person or order, it will be necessary for the payee to endorse the Bill before he transfers it to another person. This is done in exactly the same way as a cheque is endorsed, i.e. by the payee writing his name on the back. It may happen that the Bill passes through so many hands that more signatures are necessary than the Bill will carry. Further signatures may be provided for by attaching a slip of paper to the end of the Bill.

This slip is called an **allonge**, and care must be taken that the last signature on the Bill should appear partly on the Bill itself and partly on the allonge, so that if the latter becomes detached, the partial signature remaining will reveal the fact. There are a number of different ways in which a Bill may be endorsed. The more common methods are tabulated on p. 247.

The words "*value received*" are usually inserted in a Bill, although they are not necessary in the case of an Inland Bill, it being assumed that value has been received unless the contrary is proved.

An **Inland Bill** is one which is or on the face of it purports to be (*a*) both drawn and payable within the British Isles (including the Isle of Man and the Channel Islands) or (*b*) drawn within the British Isles upon some person resident therein. Any other is a Bill.

Foreign Bills.—A Bill which is drawn in one country and payable in another differs in the following respects:

(1) The stamp duty (as shown in the table).

(2) Foreign Bills are usually drawn in sets of two or three, and sent out on successive journeys, so that if the first is lost the next following can be used in its place, and thus save time. The use of one of the set cancels the remainder.

(3) Foreign Bills may be stamped after execution.

(4) The words "Bill of Exchange" are necessary in order to comply with the laws of certain countries.

Stamp Duties on Bills

	s.	*d.*
Bills payable on demand and up to three days after sight	0	1
On other Bills the stamp duty is *ad valorem*, as follows:—		
Not exceeding £5	0	1
Exceeding £5 and not exceeding £10..	0	2
,, £10 ,, ,, ,, £25..	0	3
,, £25 ,, ,, ,, £50..	0	6
,, £50 ,, ,, ,, £75..	0	9
,, £75 ,, ,, ,, £100..	1	0
and for every £100 and fraction of £100	1	0

The stamp duty on Foreign is the same as on Inland Bills, but Bills drawn out of the United Kingdom and expressed to be payable out of the United Kingdom but endorsed, negotiated or actually paid in the United Kingdom are subject to stamp duty as follows:—

When the amount exceeds £50 and does not exceed £100	0	6
Exceeding £100 6d. for every £100 or fraction thereof.		

Definitions of Terms

I.O.U.—A simple signed acknowledgment of debt, equivalent to saying "I owe you." It need not be either dated or stamped, but should bear the name of the person to whom the money is owing, and the signature of the debtor.

E. and O. E. (Errors and omissions excepted).—This is frequently inserted in invoices, and signifies that the seller will not be responsible for ordinary clerical mistakes and/or omissions.

Legal Tender: That form of payment which a creditor is bound to accept in satisfaction of a debt. In the United Kingdom the following are legal tender:—

Bank of England notes for £5 and upwards to any amount.
Currency notes of 20s. and 10s. to any amount.
Gold coins to any amount.
Silver coins to the value of £2.
Copper coins to the value of 1s. F. H.

From a painting by Sir H. H. Johnston, after a photograph lent to him by the late Carl Hagenbeck and from models set up in the Ottawa Museum.

A NORTH AMERICAN INDIAN (SIOU CHIEF).

There is a remarkable degree of similarity in the general type of American aborigines. The physical characteristics are markedly Mongolian, mixed with an ancient 'white' (Ainu) element, and it is reasonable to assume, having regard to the absence of any trace of pre-existing anthropoid apes in the New World, that the Americas were originally peopled from Asia. (See *Anthropology*, p. 212.)

Continued from page 190.

ENGLISH LANGUAGE AND LITERATURE:

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PROSE FROM SHAKESPEARE TO MILTON

BEFORE discussing Milton, the most perfect example of a classical use of the English tongue in poetry, we must take up afresh the threads of English prose and trace them along to Milton's day. The poet himself has also to be disencumbered from the débris of his own prose.

By the close of the 16th century English prose was being written in very rare instances with clearness, felicity, and dignity; but, as a rule, then, and for sixty years later, the writing was cumbrous, affected, and besprinkled plentifully not only with Latin constructions, but with Latin quotations.

Take illustrations from the period when Shakespeare was writing his great plays in London. Francis Bacon, Viscount St. Albans, and Lord Chancellor of England, was rather disappointing as a writer. It was true that he was endowed with an original and powerful intellect. He could see that sound knowledge must come from experimental research into the nature of things as they are, and so he founded the philosophy on which modern science is based.

Francis Bacon

But, though Bacon lived in an age of exultant national consciousness, he forbore to write his master-work in English. Even his *Advancement of Learning*, which first appeared in English, in 1605, was enlarged and changed into a Latin form, and in its English guise was, like the more popular *Essays*, hampered at every turn by Latin interpolations.

The one classical prose work which emerges from the period comparatively unhampered by learning, though written by a very learned man, and that shows us how the language had become adequate for the expression in prose of every variety of thought and emotion, is Richard Hooker's *Ecclesiastical Polity*.

Richard Hooker, a Devonshire man, became a lecturer in Hebrew at Oxford, and, in 1585, Master of the Temple. This appointment led to the writing of his notable book. The afternoon preacher at the Temple Church, Travers by name, was a Calvinistic Puritan, before Puritanism had been refined by persecution. He was favourable to the Presbyterian form of Church government, while Hooker was a convinced Anglican.

Hooker and Walton

Their differences resounded from the same pulpit, though each respected the piety of the other. As Thomas Fuller said, in the morning was heard the voice of Canterbury, and in the afternoon the voice of Geneva. The controversy led Hooker to re-examine earnestly the principles on which he conceived the Church of England to be founded, and he became so absorbed in writing his thoughts in book form that, after six years' tenure of the Mastership of the Temple, he asked for a quiet country benefice where he could complete his work. Accordingly he was given a living in Wiltshire, and later was transferred to Kent. When he died, in 1600, he had published five books *Of the Laws of Ecclesiastical Polity*, and three more, which underwent some partisan distortion, were issued after his death.

Hooker's life was written, with fine sympathy, by Izaac Walton. A gentle, insignificant, little man, bent, near-sighted, unhealthy, and shabby, with a vixenish wife, who after his death gave up his papers to his opponents, Richard Hooker had a mind of extraordinary grasp, and a spirit of toleration and charity most rare in those

days of bitter controversy. He may be said to have laid philosophically, and in a literary sense, the foundations of the Church of England as a broad, comprehensive, adaptable religious organisation. His liberal mind and sweet and gentle spirit foreshadowed all that is most attractive in modern Christianity.

The *Ecclesiastical Polity* will never be a popular book, for it deals with great principles, and the discussion of fundamental principles can never be popular. The style, too, is more highly elaborated than our later fashions of writing. But severe thinking is clearly expressed in the book through words that harmonise with the subject-matter, and for the first time a lofty argument is so consistently sustained in pure English that Hallam claims that the book "admirably displays the capacities of our language."

Selden's Table Talk

A book of shrewd sayings that has reached us from this time is Selden's *Table Talk.* John Selden, a friend of Jonson and Drayton, and a man of prodigious learning, lived to be the great constitutional lawyer of the period of the Civil War. He was one of the first men to make a fortune in the quiet backwater of the law now known as "giving counsel's opinion." Selden wrote much antiquarianism that is not literature, but his *Table Talk*, published in 1689, proves that his reputation for wit and wisdom was deserved.

Among books that will always be read as curiosities, apart from the main stream of literary progress, are Burton's *Anatomy of Melancholy* and Sir Thomas Browne's *Religio Medici*, or Religion of a Physician.

Robert Burton was an Oxford vicar who spent his life in warding off melancholy by writing about it with a humorous seriousness. He is a delightful writer on his own account, if the reader disregards his lumber of dead learning. The book, often revised, went through many editions when pedantic scholarship was common.

Sir Thomas Browne was a travelled doctor who practised first near Halifax and then for forty-five years at Norwich. He wrote his *Religio Medici* in Yorkshire, but it was not published by him till eight years after, in 1642. Later he wrote *Vulgar Errors* and *Urn Burial.* A curious medley of religion and superstition, science, and quackery, full of humour, but shadowed by the mystery of death, the old Norwich doctor is a complete original, and his waywardly delightful writings must be read in the light of his character, as the writings of his disciple Charles Lamb are read. Nowhere is the astonishing ignorance of the 17th century more clearly seen than in the writings of this accomplished man; but in spirit he had none of the bitter narrowness of his age. At heart he was a mystic; in style his writing was elaborated into artifice, and so loses plain strength, but no one has marshalled words with a richer enjoyment.

Writers who may be said to have started new lines of literary development during the period under review included John Earle, James Howell, and Izaak Walton. All three belonged to the Cavalier party in the days of civil turmoil, and each was a man whose personality gave interest to his writings.

John Earle wrote at the age of twenty-seven — in 1628 — a book of character-sketches, which grew in later editions to seventy-eight in number. To these pithy and witty descriptions of types, not individuals, he gave the name *Microcosmographie.* The book forms a loose link between the old humorous stage comedy and the modern novel. It was widely imitated. Earle became chaplain to the Chancellor of Oxford University, then tutor to Prince Charles.

Following the prince abroad, he retained his chaplaincy there, and was Charles's favourite cleric — perhaps for the same reasons that he was universally popular, namely, good nature, wit, and a large-hearted tolerance. After the Restoration he was made successively Dean of Westminster, Bishop of Worcester, and Bishop of Salisbury.

James Howell

James Howell was perhaps the first writer who made a living by literature apart from the stage. Of Welsh birth, he was educated at Oxford, travelled on special missions abroad, and became an accomplished linguist, but his employment in the public service was but desultory, and, falling into debt, he was imprisoned for eight years in the Fleet. There he kept himself by his pen. Two of his many writings survive in modern reprints—his *Instructions for Foreign Travel*, a series of hints towards a general guide-book, and his *Familiar Letters.* The letters are dated from foreign places, but were written in prison. Howell drew partly on his own experiences and partly on books for his information. As a writer of imaginative letters that read like the truth, he was the forerunner of Defoe. After the Restoration he was appointed historiographer royal of England.

Izaak Walton (as he wrote himself), one of the most lovable of practical philosophers and charming of writers, made a modest fortune, and many friends, at a shop close by St. Dunstan's Church, in Fleet Street. Walton's gifts to literature were the first adequate book on country life, and the earliest examples of succinct yet comprehensive and deeply sympathetic biography. He retired from business when he was fifty, and his *Compleat Angler* was published when he was sixty (1653). No doubt he had long toyed with writing. Dr. Donne, the poet, was vicar of St. Dunstan's, with Izaak as a churchwarden, and probably through Donne, the kindly, cultured citizen, formed many friendships. When Donne's poems were published, posthumously, Walton (aged forty) added an *Elegy*. He gathered materials for a *Life of Donne*, by Sir Henry Wotton, and after Wotton's death wrote the Life himself. This was three years before his retirement from business. Later he added a Life of Wotton. Then came his book in praise of angling. Lives of Richard Hooker, George Herbert, and Bishop Sanderson followed at long intervals. He lived to be ninety, and for thirty years was improving his *Compleat Angler* by additions, and by contributions from his angling friends.

From the picture by E. M. Ward, R.A.

RICHARD BAXTER IN JUDGE JEFFERIES' COURT (1685).

The remorseless and notorious judge—if only in order to gain favour with the new king, James II., a Roman Catholic—welcomed an opportunity to bully and insult the gentle but learned dissenting preacher.

As a technical treatise on angling, *The Compleat Angler* is absurd, for the gentle citizen's ideas on the subject did not go beyond fishing with a wriggling worm. Hence the need for the supplements by more expert friends. The true keynote of the book sounds in the sub-title: "The Contemplative Man's Recreation." The man is Izaak Walton, and it is his sweet and simple character, in the midst of the country scenes he loved, that makes the book a perpetual delight.

Connected more distinctively with religion than writers like Walton, four prose men of letters of the period must be named—Thomas Fuller, Jeremy Taylor, Richard Baxter, and John Bunyan.

When he was a West Country rector Thomas Fuller began historical writing with the story of the Crusades, or Holy War, as he called it, and semi-religious writing in his *Holy State and Profane State.* In the Civil War he served as an army chaplain on the Royalist side, and during his wanderings diligently collected materials for his *Church History* and *Worthies of England.* His moderation made enemies on both sides, but also gained friends who protected him from harm through political changes. After the Restoration he was made a chaplain to Charles II., but died before he received the promotion his position and powers warranted.

Thomas Fuller

The work by which he is best known is his *Worthies of England*—a medley of history, gossip, typography, and biography, geographically arranged. The natural bent of Fuller's mind was towards a humour all pith and point. His prose is strong, clear, and never tortuously clever. No English writer has condensed more wisdom into brief sayings that have a humorous bite.

Here are a few examples :—

> Of certain books : He that peeps through the casement of the index sees as much as if he were in the house.
>
> Of pedantry : It is not to be believed that wisdom speaks to her disciples only in Latin, Greek, or Hebrew.
>
> Of Recreation : It is the breathing of the soul, which otherwise would be stifled with continual business.

Jeremy Taylor, son of a Cambridge barber, was a student at the University at the same time as Milton, Thomas Fuller, and George Herbert. Before he was twenty-one he was in Holy Orders and a preacher at St. Paul's. Afterwards he became chaplain in ordinary to Charles I. and rector of Uppingham. During the Civil War he spent much of his time in Wales acting as chaplain to the Earl of Carbery at his residence Golden Grove, and there he wrote his best books, including *Holy Living* and *Holy Dying.*

At the Restoration he was given the thankless appointment of Bishop of Down, Ireland being then, religiously, in a state of hopeless confusion. In 1667 he died, aged fifty-five. Jeremy Taylor's influence was gained partly by eloquence and partly by a fine spirit of toleration. No one has represented with better balance the pulpit and literature.

Richard Baxter, the leading Nonconformist divine of the Stuart period, began his ministry in the Church of England, and only left the Church on the passing of the Act of Uniformity. Two years before he had been offered a bishopric and had refused it. Known widely as one of the most popular preachers of the age, Baxter is most closely identified with Kidderminster, where he sustained a long and profoundly successful ministry. It was during that period, in his thirty-fifth year, that he wrote a book which has had a world-wide circulation ever since—*The Saints' Everlasting Rest.*

Later, Baxter suffered bitter persecution. In 1685 he was tried by the notorious and remorseless Judge Jefferies, who, to curry the king's favour (James II., a Roman Catholic, had just come to the throne), vilely insulted him and sent him to prison. But Baxter persisted in preaching, and was a most prolific writer, the number of his publications reaching 168. Towards the end of his life he wrote his *Reliquiæ Baxterianæ : Mr. Richard Baxter's Narrative of the Most Memorable Passages of his Life and Times*—a notable autobiography.

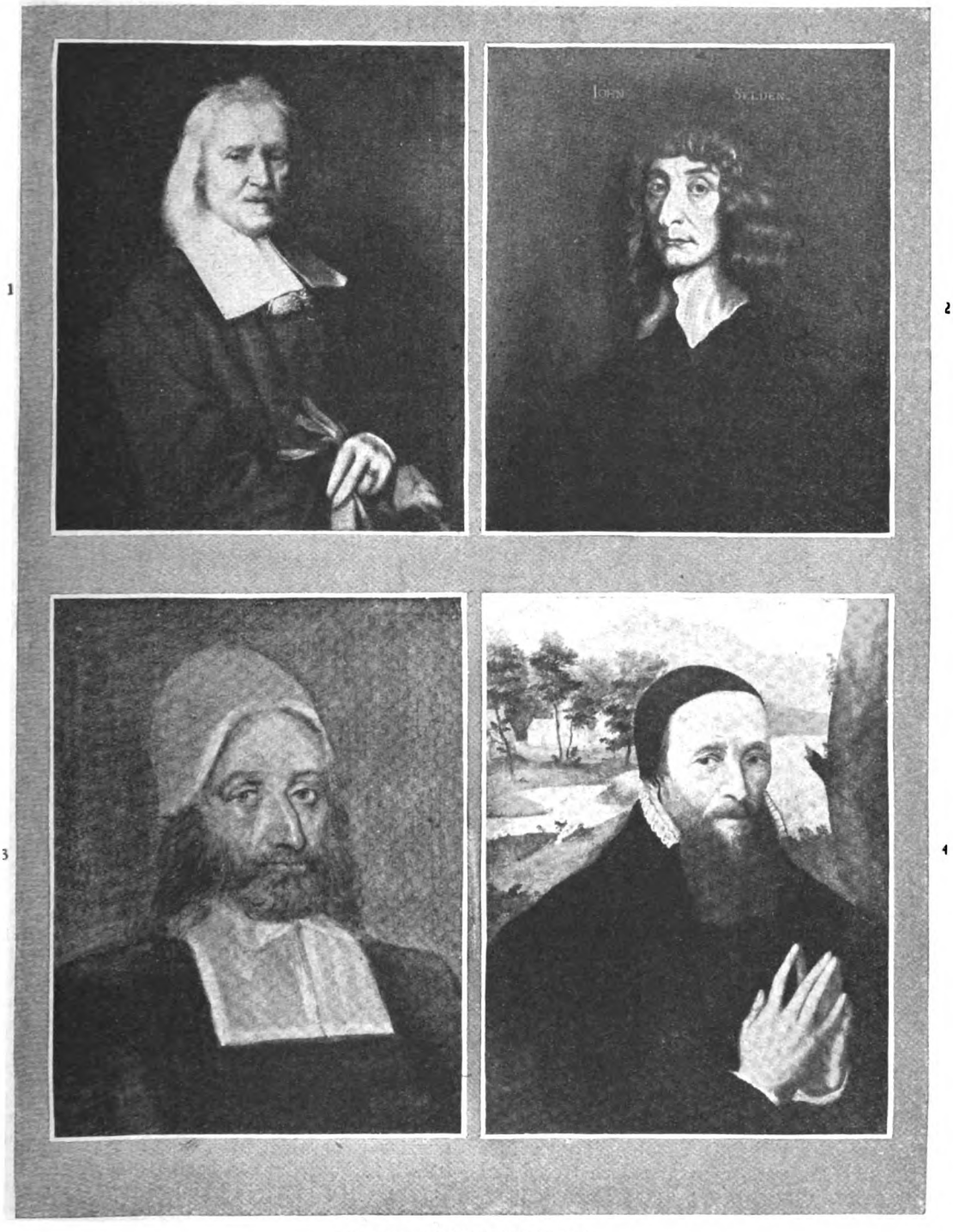
John Bunyan

A man of saintly character, he held firmly moderate opinions which won their way in the end. *The Saints' Everlasting Rest* is a book not only of purest piety, but of a lofty and moving eloquence that always appears to have been spoken rather than written, so unlaboured is its appealing style.

John Bunyan, who, probably, next to William Shakespeare has been the most popular writer of the English tongue through the longest period and over the widest area, had the enormous advantages of being an unlearned man of great power of imagination. Though he was active late in the period we are commenting on—for he was born in 1628 and died in 1688—he belonged, spiritually and intellectually, to the Elizabethan movement. In his nature he had all its warm glow and imaginative exaltation.

The son of a Bedfordshire brazier, and an apprentice to the craft, he had but a brief village-school education of the most elementary kind, and that he soon almost entirely lost in the turmoil of the Civil War, only to regain it when he searched eagerly for a personal religion and found it through a study of the English Bible.

When Bunyan, after becoming a preacher,



STILL READ TO-DAY.

1. Izaak Walton (1593-1683), author of *The Compleat Angler*; 2. John Selden (1584-1654), famous for his *Table Talk*; 3. Richard Baxter (1615-91), whose *Saints' Everlasting Rest* has had a world-wide circulation; 4. Richard Hooker (1554-1600), best known for his *Ecclesiastical Polity*, a book great in subject, style and spirit.

began to write, chiefly while in prison for conscience' sake, he wrote exclusively for a profound religious purpose, in response to an inward call, or vision; and the language he used was the Biblical language, in which his mind was steeped. From learning, as it was understood by the schoolmen, he was cut off, first owing to early illiteracy, and next by the consciousness that the Latinised allusive methods of the classical literary penman would in him be roundabout and insincere, even if he could attain to them. Never once did he sit down to turn a glowing period reminiscent of the literary models that attracted other writers of his day. Any such indirect process of expression would in his eyes have been a dallying with devilish temptation. He felt he must express what he had to say with perfect simplicity and plainness, though the form might be a parable.

Pilgrim's Progress

His powerful and imaginative mind had caught its methods of expression from the common speech of the people, refined by a Biblical vocabulary. The result is that we see in Bunyan a glorious emancipation from all the non-English learning that had so long hampered even the greatest of his prose predecessors. Hooker and Jeremy Taylor had freed themselves from a good deal of the pedantry of learning, but even they were the slaves of a formal literary verbiage—Hooker often and Taylor sometimes—while Bunyan wrote as men talk when what they say comes straight from the heart.

And, somehow, though he never sought literary grace, and apparently had no critical understanding of it—for his frequent rhymes were the baldest doggerel—yet he attained that grace in a measure beyond the reach of the finest art. Everyday English suddenly was glorified by him and made classical, with a power of enchantment like the music that will break down a man's spirit into tears.

Three of John Bunyan's many books are permanent literature, namely, *Grace Abounding*, a religious autobiography; *The Pilgrim's Progress*, a masterpiece translated into seventy languages; and *The Holy War*, an almost impossibly-complicated allegory, worked out with patient skill, and a growing power over varied language, for its author had now educated himself by his own writings.

Omission cannot be made here of Thomas Hobbes, though his most suitable rating is with philosophers rather than with men famed in pure literature. Hobbes, as he was careful to explain, was born in the year of the Armada, 1588. He gave that explanation to account for his manifest cowardice. His mother, he said, was frightened terribly by rumours of the Armada, and gave birth to twins—himself and Fear.

After an education at Oxford which he despised, he acted for a time as Bacon's secretary, and then became attached to the Cavendish family (now Dukes of Devonshire), and with intervals of flight to the Continent, when he was unnecessarily afraid, remained a tutor of successive generations, or an honoured associate of the family throughout his long life.

Hobbes spent a good deal of time abroad as tutor to young Cavendishes, or others, including Prince Charles (II.). In Italy he knew Galileo, in France the popular philosopher of the day, Mersenne, and he had controversy by correspondence with Descartes, in Holland. After he had turned fifty he began to build up in his mind a philosophical system of the universe that, if completed, would have been as broad as Aristotle's before him, or Herbert Spencer after him; but it never was completed. The part most fully developed concerned the natural philosophical foundations of a Commonwealth, and was entitled *Leviathan : or the Matter and Form and Power of a Commonwealth, Ecclesiastical and Civil.*

Hobbes and his *Leviathan*

The views advanced in this book were hotly discussed throughout the civilised world for a century. They sought to disclose natural foundations for arbitrary government. They suggest that human nature is wholly selfish and tends towards an intolerable anarchy, with war. To counteract this tendency, men agree to absolute government for their own protection, and the fiat of the government established must be final and irresponsible.

In supporting this theory, Hobbes struck some heavy blows at the influence of the Church, and aroused such opposition in that quarter that when his *Leviathan* was published, in 1651, he fled back from France to England for safety. His later years were spent pleasantly under the wing of the Cavendishes, with classical studies as his amusement.

His style in writing was clear and unadorned. Of himself he said: "There is nothing I distrust more than my elocution [or diction], which, nevertheless, I am confident is not obscure." It was a fully war-

ranted judgment, for he is one of the few writers who have discussed metaphysical topics in language no one could mistake, and in that field he may be regarded as one who extended the plain use of English.

John Milton, whose life will be traced when we outline his poetical works, was busy with religious and political controversy in pamphlet form by the year 1641, and continued polemical writings until the Restoration.

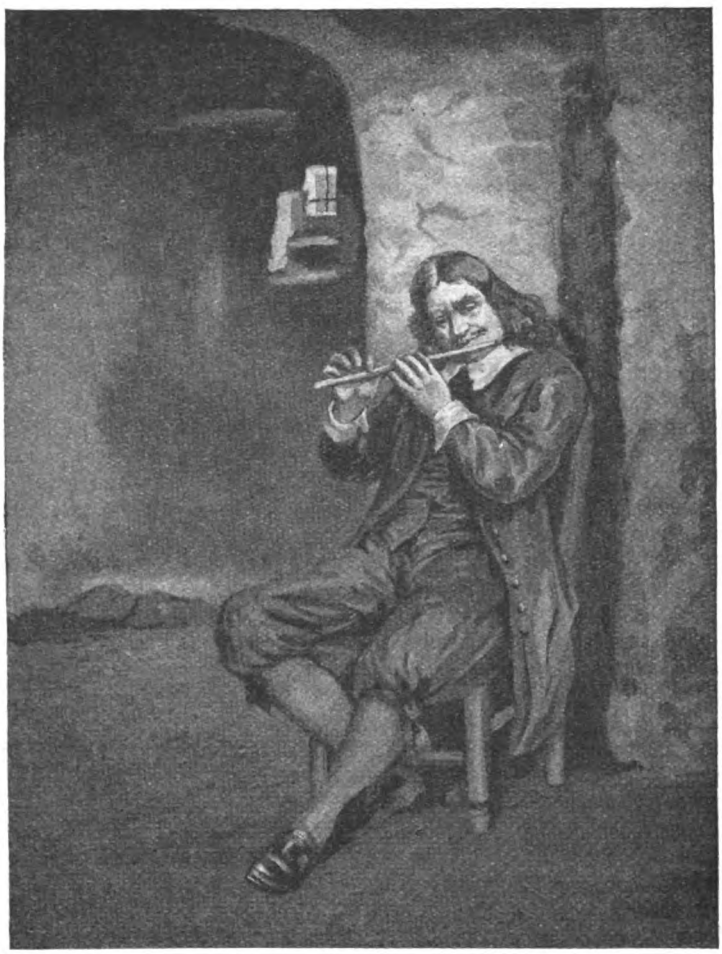
Milton's Prose

Only two of these prose writings have any lasting vitality. One, a letter on Education, remains interesting as a record of the learning that Milton recommended for the average student—a stupendous curriculum. In the other, the immortal *Areopagitica*, a defence of Freedom of the Press in an Address to Parliament, he found a theme worthy of a great poet, and produced a prose poem magnificent in its eloquence.

No one can ever wish the *Areopagitica* away. Its bursts of noble thought and of splendid faith in the power and sacredness of untrammelled liberty for the human mind have enriched our language with a stately specimen. But still it is only a specimen. Even for its own lofty purpose the *Areopagitica* was, as prose, somewhat overwrought. It almost deserves Macaulay's description of it as "a field of cloth of gold stiff with gorgeous embroidery."

A passage on the invulnerability of Truth will illustrate the style of the *Areopagitica*:

> Though all the winds of doctrine were let loose to play upon the earth, so Truth be in the field, we do injuriously by licensing and prohibiting to misdoubt her strength. Let her and Falsehood grapple; whoever knew Truth put to the worse in a free and open encounter? Her confuting is the best and surest suppressing. . . . . When a man hath been labouring the hardest labour in the deep mines of knowledge, hath furnished out his findings in all their equipage, drawn forth his reasons as it were a battle ranged, scattered and defeated all objections in his way, calls out his adversary into the plain, offers him the advantage of wind and sun, if he please, only that he may try the matter by dint of argument; for his opponents then to skulk, to lay ambushments, to keep a narrow bridge of licensing where the challenger should pass, though it be valour enough in soldiership is but weakness and cowardice in the wars of Truth. For who knows not that Truth is strong, next to the Almighty? She needs no policies, nor stratagems, nor licensings to make her victorious; those are the shifts and the defences that error uses against her; give her but room, and do not bind her when she sleeps. J. D.



JOHN BUNYAN (1628-1688),

the author of *Pilgrim's Progress*, was a tinker by trade and one of the most powerful preachers of his time. In this latter capacity he suffered, as a nonconformist, under the various Acts which were revived at the Restoration, and he spent twelve years (1660-72) in prison, where he is shown above, whiling away his lonely hours.

Continued from page 195.

HISTORY:

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THE MEDIÆVAL EMPIRE AND THE PAPACY

THE outstanding feature of European history during the eleventh century was a momentous struggle between secular authority and the bold pretensions of the Roman See to universal supremacy.

At the beginning of the controversy, the kingdoms of England, France and Spain had scarcely yet attained substantial political organisation. The task of opposing the Papacy devolved, therefore, almost exclusively upon the rulers of Germany.

Now, the Germany of those days was a federation of several states, which in the latter part of the tenth century became united under the nominal control of the ruling house of Saxony. This was the beginning of the so-called Holy Roman Empire, for in 951, as we learned in Vol. 1. (see page 272), the Pope invited the Saxon ruler, Otto the Great, to interfere in the affairs of Italy, which were then in a state of great confusion. Eleven years later the Pope rewarded Otto for his services by giving him the Italian kingdom, and crowning him Emperor at Rome.

German Imperialism

But the artificial connection thus established between Italy and Germany benefited neither country. The Italians, galled by a sense of subjection to a people inferior to themselves in the arts of civilisation, could never bring themselves to submit willingly to the new imperial yoke; whilst the Emperors, distracted by the need of maintaining in Italy that authority which was essential to their title, were prevented from giving a proper attention to the affairs of their own country.

In the days of the old Empire, Rome had been a centre from which laws, culture, and military organisation had radiated over Europe. Roman imperialism, therefore, though productive of some evil effects, undoubtedly proved beneficial to the western world. The imperialism of Germany, on the other hand, was not a natural growth; it was the result of an accident, and, while strong enough to irritate, was powerless to bring about any solid or lasting good.

The Saxon dynasty continued to reign until 1024. The male line then came to an end, and Conrad of Franconia (i.e. of Teutonic or Eastern Francia as opposed to Latin or Western Francia, the land we now call France) was elected King of Germany. In 1027 Conrad was duly crowned Emperor, and his descendants in three successive generations bore the imperial title.

Church and State

It was during the reign of Conrad's son—the Emperor Henry III., a ruler of exceptional ability—that the Papacy began to make its bold bid for supremacy in Europe, at the expense of the Empire.

When Henry III. ascended the imperial throne, nobody could have foreseen that such a struggle was about to begin. The Roman Church, as an organisation, was then utterly moribund; and there is nothing more remarkable in the whole course of history than the manner in which the Papal See during the eleventh century rose from the lowest depths of degradation to the dizziest heights of pride and power.

At the beginning of the century the Church appeared to be in a state of disintegration, and to be rapidly dissolving into a number of feudal units. This was due largely to the vast territorial possessions of the clergy. In some of the countries of Europe so much as one-half of the land—one-half in value if not in area—had fallen into the hands of ecclesiastical owners, but not, in actual fact, into the hands of the Church, for rulers of states, if only in order to prevent their realms from being drained of revenue, had been forced to bring bishopries and abbeys into feudal relations to themselves.

But the ordinary rules of feudal tenure

could not be made to apply to ecclesiastical landlords. Priests were forbidden by the Church to marry. Thus neither bishops nor abbots could legally have children to whom to hand on their properties. When a landed churchman died, therefore, it became necessary for someone to be chosen to hold his property, as well as to undertake his duties.

According to canonical law, it was the privilege of the clergy of the diocese to choose their own bishop; whilst the Rule of St. Benedict laid down that the members of a monastery should select their own abbot. In theory, of course, this procedure was very sound. Indeed, it was eminently desirable that the clergy should elect their own bishops, and the monks their own abbots. But, seeing that by the eleventh century bishoprics and abbeys almost invariably had vast estates attaching to them, the ruler of the state was forced in self-defence to claim a voice in the election, and to take steps to ensure the loyalty of newly-appointed ecclesiastical dignitaries.

Moreover, he usually experienced but little difficulty in achieving his purpose. The average churchman of the eleventh century was neither conscientious nor devout, and attached far more importance to the financial and political prospects of high ecclesiastical appointments than to their spiritual dignity.

Simony

Churchmen such as the English Archbishops Anselm and Stephen Langton, who fought relentlessly against the secularising policy of Kings Henry I. and John respectively, were rare in the Mediæval Church. Their brethren, for the most part eager to secure good appointments, were only too willing to accept Church lands from the king on terms of feudal tenure, and even to allow the king to invest them with the spiritual emblems of office. And this—though, no doubt, it increased the power of individual prelates—did not make for strength in the Church.

As a matter of fact, the rule forbidding clergy to marry was, during the tenth century, silently but openly ignored all over Europe. This led to additional complications, for, although the more devout divines sternly denounced the "unspeakable abomination" of married priests, clerics, as well as laymen, were confronted with the problem of providing for their children; and, in consequence, lands originally dedicated to the Church tended, like lay property, to become hereditary, and to pass as a matter of course from father to son.

Had this process been allowed to continue indefinitely, the Church, of course, would have lost all her territorial possessions. It was largely on this account, therefore, that the great reformers of the eleventh century insisted that priests should be wedded only to the Church.

But perhaps the greatest menace to the Church at this time was the shameless manner in which benefices were bought and sold. *Simony*,* as this practice was called, though strictly forbidden, was very common. That this should have been the case is easily explained. Many Church appointments were very remunerative; whilst the duties attached to them were very light. There was keen competition, therefore, to secure such posts; and, as was inevitable in a corrupt age, the prize usually went to the highest bidder.

The See of Rome itself frequently was bought and sold.

Pope Leo IX.

In the year of the Emperor Conrad's coronation, a layman actually ascended the Papal chair. He was succeeded by a dissolute youth who styled himself Pope Benedict IX., and for several years led a life of unbridled licence. At length, however, he publicly announced his intention of marrying. This was a violation of tradition which even the tolerant citizens of Rome could not allow themselves to suffer; and they drove Benedict from the city.

The See was then bought by the wealthy Bishop of Sabina. But he was not allowed to enjoy undisputed possession of the office. First he had to carry on a struggle with the expelled Benedict IX.; and subsequently—when the latter had grown weary of the strife—with another cleric to whom Benedict had sold his claim, and who assumed the title of Gregory VI.

Shocked by the scandalous condition into which the Roman See had fallen, an independent party of the clergy addressed an appeal to the Emperor, Henry III., imploring him to terminate, by force of arms if need be, this state of affairs.

Henry, impressed by the representations made to him, immediately set out for Italy at the head of a considerable army. Instead, however, of advancing directly against the city of Rome, he halted at Sutri in Umbria, and there summoned a general council of

* The word *simony* is derived from the name of Simon Magnus, whom, it will be remembered, St. Peter denounced for offering to buy from him the power of conferring the Holy Spirit.—See *The Acts of the Apostles*, viii. 20.

ecclesiastics. This assembly resolved that steps should be taken to force each of the rival claimants to renounce all pretensions to the Papal office ; and, when this had been done, proceeded to elect the Emperor's nominee, the German Bishop of Bamberg, for the vacant See.

The new Pope styled himself Clement II., but he did not long survive his elevation. His successor, Damasus II., moreover, lived only twenty days ; and, since both these Popes were Germans, whose appointment undoubtedly was obnoxious to many of the Italians, it is permissible, perhaps, to entertain suspicions as to the probable cause of their premature decease.

But with the election of Leo IX., who succeeded Damasus II., there began a new era in the history of the Papacy.

Leo also was a nominee of the Emperor, having been Bishop of Toul, in Lorraine, prior to his elevation. But he declined to make use of imperial support to hasten his own advancement, for he aspired to the gigantic task of raising the Church to the position of a great international power, and had no intention of allowing himself to be handicapped in this work by a sense of obligation to anyone. He insisted, therefore, on entering Rome as a barefooted pilgrim, and there undergoing a formal election in accordance with the rule of the Church.

Cardinal Hildebrand becomes—

By nominating such a man for the supreme leadership of the Church, and by so lifting the Papacy above the level of petty Italian politics, the Emperor Henry unwittingly raised a dangerous rival to his own authority —a rival, moreover, whose successors during the course of the next two centuries were destined to dominate all Western Europe, and completely to overshadow imperial rule.

Leo IX. was aided and influenced in his energetic policy by Cardinal Hildebrand, a great Churchman, who laboured assiduously, during five successive popedoms—twenty-five years in all—before he himself became Pope, to correct the faults of ecclesiastical administration, and to augment its power.

Lec IX., acting on the advice of Hildebrand, devoted his reign mainly to the conduct of a vigorous campaign against simony and the marriage of clergy. Leo IX. died in 1058 ; and it was his successor, Nicholas II., who took the first real step towards the emancipation of the Church from secular authority.

In 1059 he issued a decree ordaining that in future, on the decease of a reigning Pope, the Cardinals at Rome should meet in separate conclave and, by their unanimous agreement, elect someone to fill the vacant office. He further ordained that " no clerk in orders shall hereafter, on any pretence whatever, accept church or benefice from or by the procurement of any lay person " ; also that " no clerk in orders shall be amenable to lay jurisdiction."

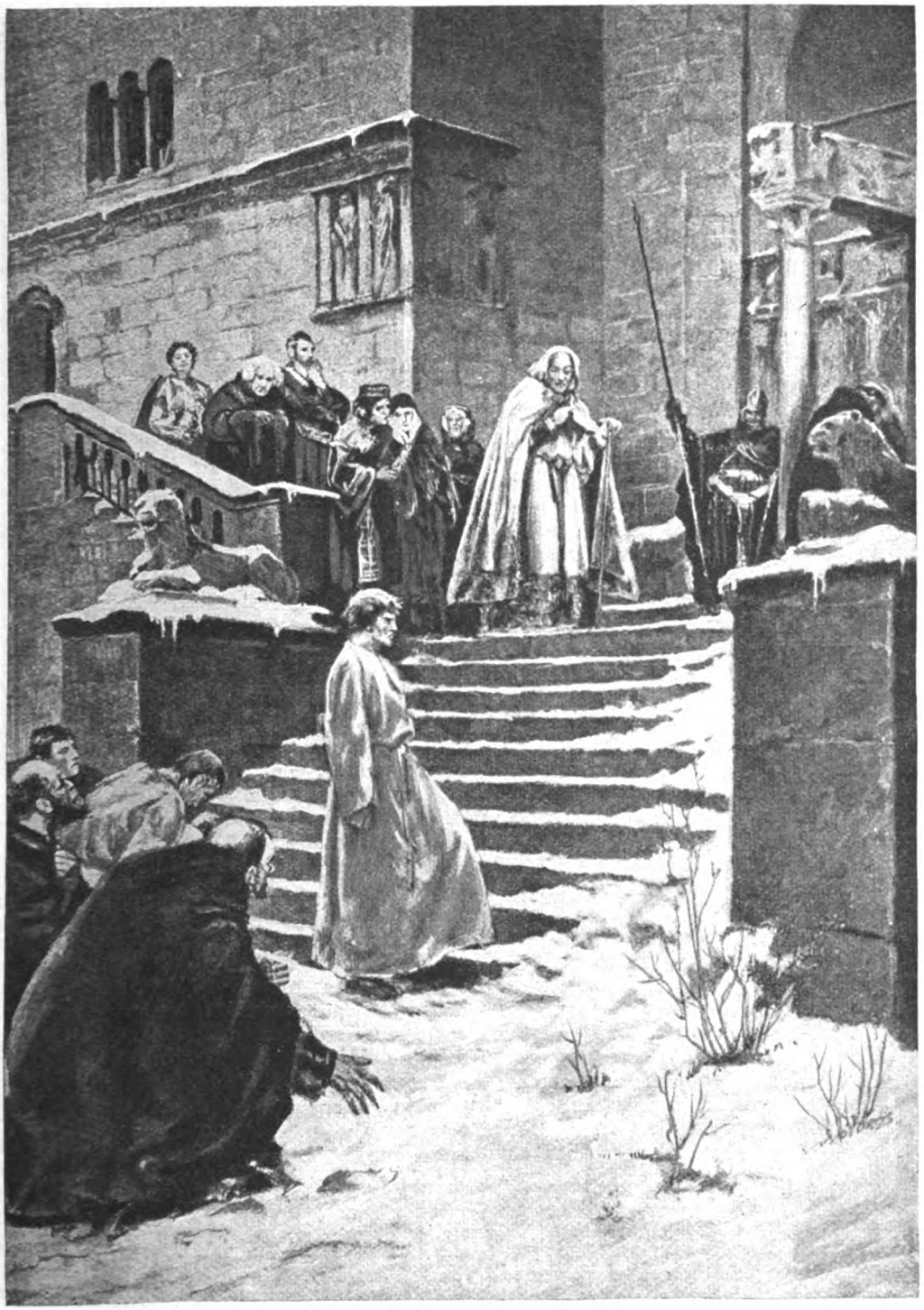
These resolutions met with opposition both from within the Church and from without, the two latter proving a constant source of friction between the Papacy and the various monarchies of Europe.

—Pope Gregory VII.

In 1073 Hildebrand himself was elected Pope. He ascended the Papal throne with some reluctance ; none the less, as Gregory VII., began his reign with a firm determination not merely to maintain the privileges of the Church, but to exercise a corrective supervision over all the temporal rulers of Christendom, as well as to maintain the privileges of the Church. He chose to regard himself as the head of a great Ecclesiastical Empire, and maintained that, in addition to spiritual obligations, the rulers of Christian countries owed direct political allegiance to Rome, as vassals holding fiefs of the Papacy.

The Emperor Henry III. died prior to Hildebrand's elevation, and was succeeded by his son, Henry IV., who began to reign when only ten years of age. From this boy the Pope demanded an even more implicit obedience than from the other princes of Europe. As " King of the Germans " he was, Hildebrand admitted, entitled to become " Emperor "—but only if, and when, he should be crowned by the Pope at Rome. In the meanwhile, therefore, Hildebrand argued, Henry was specially bound to the Pope—not merely as a vassal holding the crown of Germany in feudal subjection, but as the official lay minister, the political and military agent, of the Roman See ; what later Popes called " the eldest son of the Church."

This theory of the relations between the Papacy and the Empire was not invented by Gregory VII. It was the interpretation which many clerical writers had laboured to put on the events of the past. They showed how even Charlemagne had often promulgated laws as resulting from the advice or request of the head of Christendom ; and how, whenever he annexed new territories he procured the formal sanction of the Pope.



THE EMPEROR HENRY IV. HUMILIATED AT CANOSSA.

In 1076, excommunicated and helpless, the Emperor—in order to bring to an end his long struggle with Pope Gregory VII.—crossed the Alps barefooted, in midwinter, and presented himself, a penitent, at the castle of Canossa where the Pope was staying. For three days he waited in the courtyard of the castle, then deep with snow, before the Pope would receive him and grant him absolution.

And, indeed, that such was the ostensible constitution of the Empire under its founder, and his immediate successors in the ninth century, is proved by the language of their edicts. Under the Saxon emperors, it is true, the working of the constitution had been greatly modified—but only because the Papacy at that time had been in a degraded, feeble condition. Legally, therefore, Gregory felt he had abundant justification for attempting to reassert the authority of the Pope.

Now Henry IV., whose reign was embarrassed from the outset by rebellion and civil war, was ill-equipped to resist such encroachments upon the privileges that had been claimed by his immediate predecessors. Had he been allowed to act on his own initiative, he might—and probably would—have consented to a diminution of his own prerogative, and thereby have saved himself—and posterity—an infinity of trouble. But Henry was not allowed to exercise his own discretion; a number of worldly-minded German prelates, knowing that Gregory would not spare them if he succeeded in establishing the absolute supremacy of the Roman See, urged the hot-headed boy to resist the pretensions of the Papacy.

Henry IV and the Papacy

In 1074 the outbreak of a serious insurrection in Saxony rendered perilous Henry's position in Germany. In the hour of his extremity the unhappy boy appealed to Rome for Papal mediation. Gregory listened to the request; and, having persuaded the Saxon rebels to conclude a truce, promised Henry his support—on condition that he would undertake to dismiss immediately certain of his ministers, including three bishops who had been guilty of simoniacal practices.

In order to secure the Pope's support, Henry readily agreed to these demands. But in the following year, his position having in the meanwhile considerably improved, he went back on his word, recalled his old ministers, and, acting on their advice, recklessly violated the truce with Saxony that had been enjoined upon him.

By doing so, he forfeited for ever the sympathies of the Pope; and, since he proceeded then wantonly to violate a recent Papal decree relating to ecclesiastical reform, Gregory deemed the time had come for him firmly to assert his authority. Accordingly he summoned Henry to Rome to explain his conduct, warning him that, if he failed to appear, "he would be cut off from the body of the Lord, and be smitten with the curse of the anathema."

Henry received the summons with a mixture of anger and haughty derision. It was clear, he remarked, that, if he were to be a king, Hildebrand must cease to be Bishop of Rome. Forthwith, therefore, he convened a diet at Worms, where, thanks to the support of two archbishops and twenty-four bishops of Germany, a resolution in favour of Gregory's deposition was carried. Letters from the king were then addressed to the clergy and people of Rome announcing the deposition of "the false monk Hildebrand."

Gregory's reply was even more drastic in tone. He denounced Henry as an enemy of the Church; absolved Christians from all oaths of obedience to him; then, still using the power of binding and loosing which, as Pope, he claimed to have inherited from St. Peter, declared Henry "bound with the bond of anathema."

The Story of Canossa

The great duel of rival authorities had now really begun; and from the initial encounter the Papacy emerged victorious, for, while the Pope could afford to ignore Henry's bombastic pronouncement, it soon became clear that, as a result of Gregory's decree, Henry could no longer command the allegiance of a great majority of his subjects. Indeed, although he managed to persuade the Bishop of Utrecht to pass a sentence of excommunication on the Pope, the king's position became so desperate that towards the end of the year 1076 the princes of Germany openly debated the question of deposing him. Eventually they referred the matter to the Pope. Gregory returned a studiously gentle, moderate reply, in which he expressed the hope that Henry even yet might mend his ways and acknowledge his submission to the Church. In this case, he said, Henry need not be deprived of his royal dignity; but if he remained impenitent, then, added Gregory, the princes of Germany could lawfully choose another king—subject to the Pope's approval.

This pronouncement brought Henry immediately to his knees. Learning that the Pope was then staying at Canossa, he crossed the Alps in midwinter as a pilgrim, presented himself barefoot before Gregory, begged for, and eventually was granted, absolution.

It was however in no way pleasing to the princes of Germany that the king should become a puppet in the hands of the Pope. They now proceeded, therefore, to depose Henry without consulting Gregory, and to elect Rudolf of Swabia in his stead.

The next few years were occupied with a bloody struggle between the rival claimants to the throne. Gregory remained neutral, until, at last, weary of Henry's intrigues, he passed a second sentence of excommunication on him, and declared Rudolf king.

The effect of this action was the very reverse of what Gregory had expected. Fearing that Rudolf would prove an easy tool in Gregory's hands, the German princes now rallied round Henry, who, in 1084, advanced into Italy at the head of an army, drove Gregory from Rome, established a nominee of his own in the Papal chair, and on the following Sunday (Easter Day) was crowned Emperor at St. Peter's.

Thus ended the struggle between Henry IV. and Pope Gregory—with an unexpected victory for the former. This success, however, availed Henry but little. Attacked successively by rebellious sons, his reign ended with a forced abdication in 1106.

But the Church had still to carry on a long struggle before finally she vindicated her claim to independence from secular control; and it was not until the thirteenth century that the Papal claim to universal supremacy can be said to have become really effective. That claim, however, roused the apprehension not only of princes, but of peoples, and so prepared the way for the emancipating movement of the Reformation.

After the death of Henry IV., the political power of the Empire was overshadowed by that of the newer and more virile kingdoms. The Franconian dynasty came to an end in 1135 with the death of Lothair II. who succeeded Henry V., the husband of Matilda, daughter of Henry I. of England.

Henry V. stoutly maintained his predecessor's struggle with the Papacy. In 1111 when he went to Rome for his coronation, the Pope (Pascal II.) demanded that he should renounce the right of investiture. Henry refused, and laid hands upon the Pope and carried him, a captive, from Rome. This drastic move, however, availed him nothing; he was subsequently excommunicated and forced to yield his bold pretensions.

The Hohenstaufen, or Swabian, Emperors who followed — notably the great Frederick Barbarossa (1152-1190) — strove valiantly to restore imperial greatness. But, despite their efforts, the Empire, as a political force, steadily declined, the Emperors being forced to dissipate much of their energy in a useless endeavour to preserve their territories in Italy, where they found themselves confronted by a stubborn league of hostile Lombard cities. J. A. B.

From the Painting by F. Lessing.

HENRY V. AND POPE PASCAL II.

who demanded of the Emperor, when the latter went to Rome to be crowned in 1111, that he should renounce his claims to the right of investiture. Henry refused, laid hands on the Pope, and carried him, a captive, from Rome.

Continued from page 214.

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Contributors:—ANTHROPOLOGY AND ETHNOLOGY (Sir H. H. Johnston, G.C.M.G., K.C.B.). ASTRONOMY (Arthur R. Hinks, M.A., F.R.S.). BOTANY (E. W. Edmunds, M.A., B.Sc.[Lond.]). CHEMISTRY (E. H. Tripp, Ph.D.). ELECTRICITY AND MAGNETISM (L. M. Parsons, M.Sc., D.I.C., F.G.S.). GEOLOGY AND MINERALOGY (Arthur Holmes, D.Sc.[Lond.], A.R.C.S., D.I.C., F.G.S.). PHYSIOLOGY (Sir Malcolm Morris, K.C.V.O., and D. W. Carmalt-Jones, M.A., M.D.[Oxon.]). SOUND, LIGHT, AND HEAT (E. W. Edmunds, M.A., B.Sc.[Lond.]). ZOOLOGY (E. A. Bryant and Ashley G. Brown, F.Z.S.).

CHEMISTRY.—XIII

The Atomic Theory.—Up to now our studies have been confined to matters of undubitable fact—i.e. to phenomena which present themselves to direct observation; and many of these facts have been conveniently summarised in the form of Laws.

A scientific law is of a totally different nature to a legal law. The latter expresses a command or injunction and is couched in the imperative mood; the former is a general statement of facts, a writing-out of our experience in a very terse form, and as such its sense can only be conveyed by the indicative mood. Laws of Nature can never be causes, so that it is erroneous to use such an expression as: "The elements combine in fixed proportions by weight because of the Law of Constant Composition." That law merely states the general truth that elements do so combine, and makes no pretension to give the reason why.

Since laws of Nature are formulated by man, they are not the irrefutable, irrefragable truths they are often claimed to be. It sometimes happens that incorrect observations have been made, and when the mistake is discovered, the statement asserted in the law has to be amended. But although such laws are by no means always infallible, yet the order of Nature, the sequence of phenomena upon which the laws are based, is uniform and constant.

There is no vacillation in the order of Nature; a phenomenon which occurs under certain conditions, will recur when those conditions are repeated; the causes which operate to-day were in operation in the past, and we have the strongest grounds to believe will be equally operative in the future. The above truth is itself a law and perhaps the most fundamental law of all. It is known as the *Law of the Uniformity of Nature.*

The household of Science is not entirely composed of matters of fact, matters of belief also have their place, and without them the art of scientific discovery would be impossible. In daily life many errors of judgment are perpetrated owing to the common habit of confusing matters of fact and matters of belief. The strictly scientific man does not fall into such errors, at least in his science, he makes sure of his facts first and then utilises them in spinning his fancies, which he calls hypotheses and theories.

No hypothesis or theory will be of lasting value unless it somewhere finds contact with the solid rock-bed of fact: it will lead only to the arid desert of speculation, and he who revels therein will be no more successful than a bird which tries to fly in a vacuum.

A hypothesis, then, is an assumption, a supposition or belief which is brought forward with the object of "explaining facts," and to be credible it must be probable, it must be in accordance with the ordinary course of Nature. A theory is essentially the same as a hypothesis, it may be regarded as a hypothesis which has attained a high degree of probability and which can be applied to a considerable number of similar cases.

The expression "explaining facts" itself needs explanation. A donkey's bones are found near a human encampment (fact); it is surmised that they were left there by a marauding lion who had eaten the flesh (hypothesis). The supposition is probable because it is a long-established fact that the king of beasts is very partial to the fleshy parts of a donkey. The hypothesis explains the fact by connecting it with a lion, which is also an object of experience.

The theory of indivisible particles, or atoms, which the chemist uses to explain many facts in Chemistry, is of a somewhat different kind to the hypothesis in the illustration. He attempts to "explain" the facts of chemical combination by connecting them with the indivisible particles, which are not objects of experience but merely figments of his own imagination.

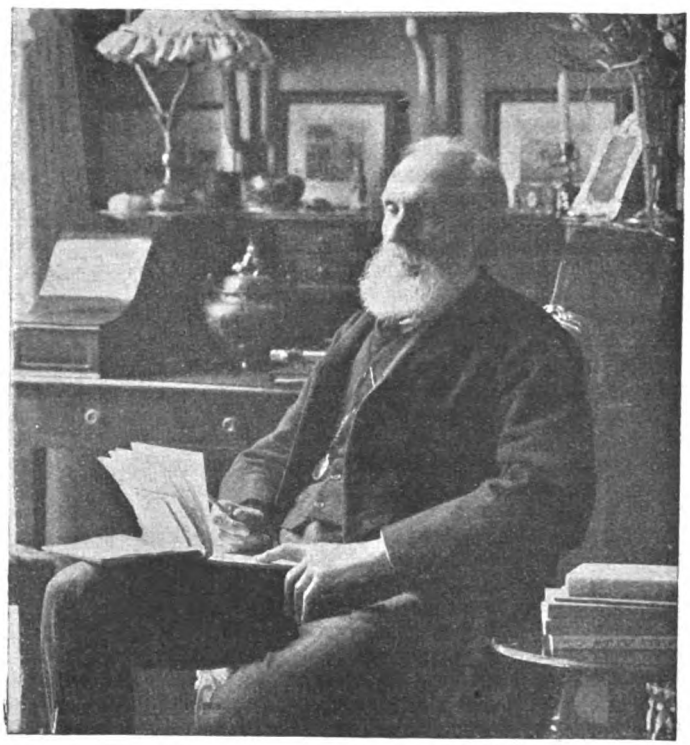
The *Atomic Theory* assumes that the elementary substances, of which all forms of matter are composed, are made up of exceedingly small particles which in the course of chemical changes do not undergo any further subdivision. These are called *atoms.* All atoms of the same element are exactly alike, having the same properties and the same weight; but atoms of different elements

are unlike. These infinitesimal particles do not as a rule exist in single blessedness, but go about in clusters, called *molecules*.

The molecule of an element is composed of like atoms; that of a compound of unlike atoms. Hence, a molecule may be defined as the smallest mass of any substance, whether an element or a compound, which is capable of existence in the free state; an atom is the smallest mass of an element which can take part in any chemical action. Thus the smallest quantity of water theoretically possible is a molecule, made up of atoms of hydrogen and oxygen; break up the molecule and you no longer have water, but atoms of the elements hydrogen and oxygen.

The combination of hydrogen and oxygen to form water should be visualised as follows: The gases are mixed and the mixture therefore contains free molecules of each of them. A light is applied, the molecules are broken down into atoms which, however, immediately combine, hydrogen atoms with oxygen atoms, to form new molecules of hydrogen oxide.

The hypothesis that matter has a grained or granular structure is of very great antiquity and probably originated in India, but it remained a barren speculation until in the early years of the nineteenth century John Dalton revived it, modified it and applied it to scientific uses. Since that time it has been further modified and extended, and the range of its application has been so enlarged that to-day it forms one of the most serviceable implements that the research chemist keeps in his armoury. It will be generally admitted that there is nothing improbable in the idea that matter consists of minute particles which in their turn are composed of smaller particles.



LORD KELVIN (William Thomson) 1824–1907,
the great British physicist. In connection with the Atomic Theory, physicists, generally, demand that every molecule should have a motion of its own, a motion greater in the case of gases than of solids.

Although it is unnecessary for the beginner to assume the existence of anything smaller than the atom, yet he should be aware that recent work on radium leads to the conclusion that the atoms themselves contain smaller particles (electrons), and that in other respects also the conception of the atom, as sketched above, is not quite in accord with recent research.

We must next inquire how our hypothesis "explains" the phenomena of chemical change. In a physical change, e.g. the conversion of water into steam, the molecules of hydrogen oxide remain intact; in a chemical change, e.g. the electrolysis of water, these molecules disappear and new molecules of hydrogen and of oxygen take their place.

The Law of the Conservation of Matter states that however much the form of material substances may change, yet their total weight is unalterable. The atomic view of this truth is that the primordial atoms are eternal, they may group and associate themselves in a thousand ways, but their mass never alters. "*Elements combine in definite proportions by weight.*"

The union of elements consists in the union of their atoms. Since every atom has its own invariable weight, the relative weights of the combining elements will always be the same, and the compound produced will never vary in composition or properties because its molecules are always composed of the same number of the same kind of atoms.

The absolute weight of atoms is of no moment to the chemist; he is only concerned with their relative weights, and to obtain these he selects the atom of hydrogen (the lightest element) as unity, and by means which are at present beyond our comprehension he ascertains how much heavier all the other atoms are than this unit atom of hydrogen.

The oxygen atom is found to be 16 times, and the magnesium atom 24 times heavier than the hydrogen atom. When these two elements combine, their molecules are first split up, and then each magnesium atom set free combines with a liberated oxygen atom to form a molecule of magnesium oxide.

Accordingly, each molecule of the latter will contain magnesium and oxygen in the proportion

of 24 : 16 ; and what is true of one molecule will be true of all molecules. According to this theory, the combination of magnesium and oxygen in the proportion of 3 : 2, which every accurate experiment demonstrates, is a direct consequence of the existence and combination of atoms of these two elements whose weights are in the same ratio.

In other words, if we assume the existence of atoms as above described, their combination of magnesium and oxygen in a fixed proportion follows as a logical consequence ; which is a striking testimony to the *utility* of the hypothesis but in no way *proves* it. The Law of Multiple Proportions has been illustrated with reference to the two oxides of copper (*Experiment* XXXVIII.). If the molecule of the black oxide consists of one atom of copper and one atom of oxygen, then to construct a molecule containing more copper we must add at least one more atom of copper to it, for the atom is by hypothesis indivisible. The new molecule will then contain exactly double the weight of copper, relatively to the oxygen, that the molecule of black oxide contained, and in this way a molecule of the red oxide is obtained.

If we represent the atom of copper by © and the atom of oxygen by O, after the manner of Dalton, the molecules of the two oxides appear as follows :

Cupric oxide ©O Cuprous oxide ©OO

If two elements, then, combine in more than one proportion, and each element consists of atoms of fixed weight, it follows that there must be some simple numerical relation between the weights of either one of the elements which combines with a fixed weight of the other.

These explanations of the combination of elements in fixed and in multiple proportions given by the Atomic Theory thus consist of "mental pictures" of hypothetical particles. If the objection be raised that this kind of hypothesis is not valid because it is an explanation of the known in terms of the unknown, the answer is that it must either be this or nothing, for the alternative theory, that there are no particles at all, that matter fills space continuously, affords no elucidation of the phenomena of chemical action whatever.

There is a school of very able chemists which repudiates the doctrine of atoms and molecules, and holds that it is useless and unscientific to try to penetrate "beyond the veil" of phenomena. All science can do is to weigh and measure and trace the sequence of phenomena and the relations which exist between them. The opposing school maintains that even if this doctrine is but a fiction it is an extremely useful one, for it not only aids by enabling us to study chemical changes from one common point of view, but it has proved to be immensely fertile in promoting discoveries.

Although of no immediate use to the chemist the calculated size of molecules is not without interest. The diameter of a molecule is given as 0·6 $\mu\mu$ (see Vol. I., p. 20), and it would take forty million touching one another to make a row one inch long.

Lord Kelvin gave the following illustration as an aid to the conception of the size of a molecule. If a globe of water as large as a football were magnified to the size of the earth and the constituent molecules magnified proportionately, then the magnified structure would be coarser-grained than a heap of small shot, but finer-grained than a heap of footballs.

Physicists demand that every molecule should have a motion of its own, which is greatest in the case of gases and least in the case of solids. An average gas-molecule moves at the rate of nearly a quarter of a mile in a second ; it never gets this distance or anything like it because it is ever colliding with its neighbours. It makes about 5,000 million collisions per second. With the aid of this conception of molecular motion, many physical phenomena can be "explained."

The pressure of a gas is due to the bombarding effect of its molecules upon the walls of the vessel which contains it. The expansion of a substance owing to influx of heat is due to the accelerated motion of the molecules, which would involve a greater average distance between them. Unfortunately for the theory, a few substances, notably water between 0° and 4° C., contract when heated, and it is not easy to reconcile these exceptions with the above explanation.

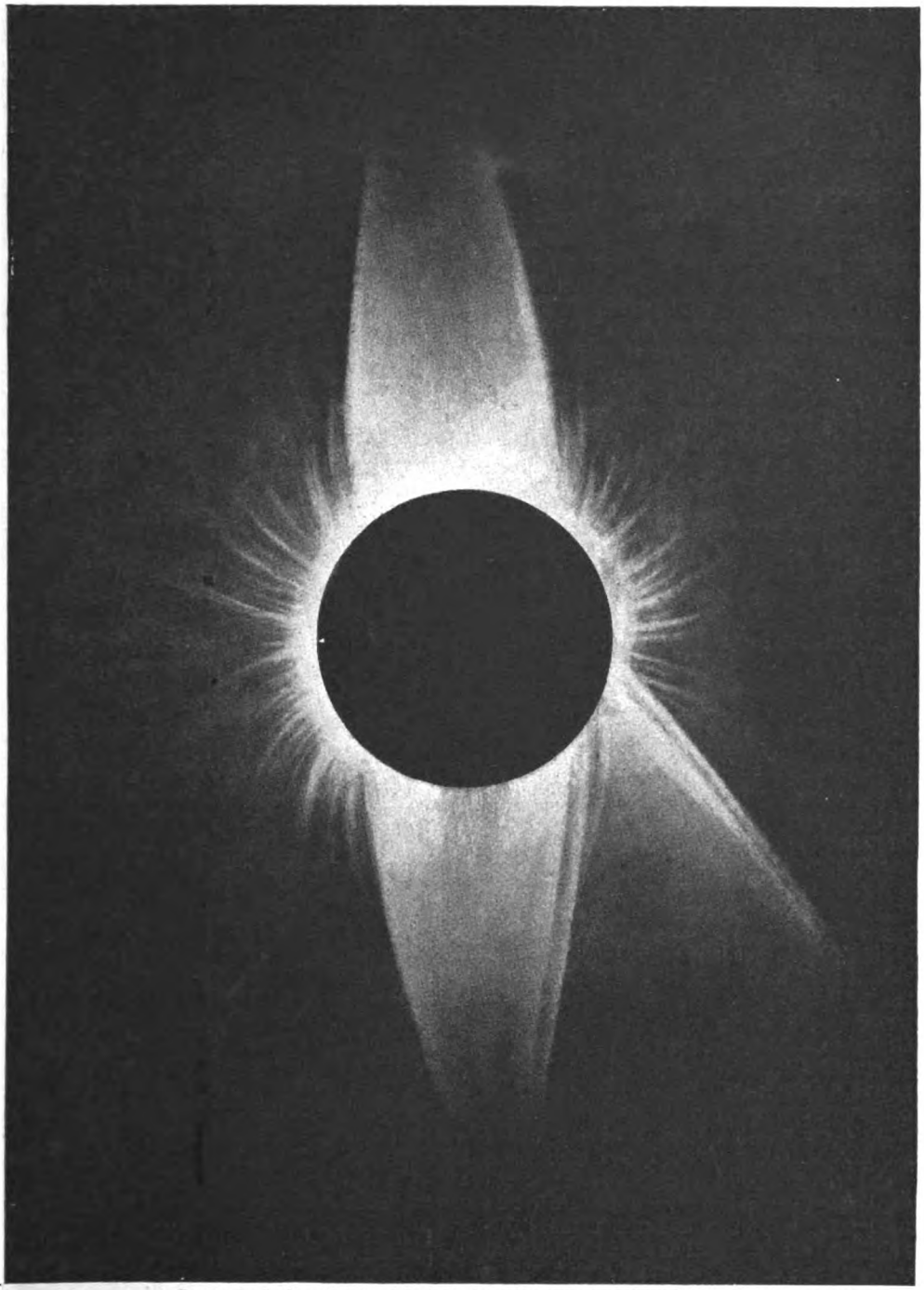
E. H. T.

LIGHT.—I

1. Nature of Light.—Light is the name given to the agent that renders objects visible. In a perfectly dark room, nothing can be seen; but when a light is put on the objects in the room can be separately distinguished by means of the light. Proceeding from the objects, the light passes to the eye and falls on to its sensitive layer, the retina, producing there an influence which is carried by the optic nerve to the brain, where the *sensation* of sight is aroused. There are thus three steps involved in our conscious vision of an external object: the first physical, the second physiological, and the third psychical. Here we deal only with the physical agent, light, which is the starting-point in the sequence: with the mysterious question, what happens on the retina and in the mind, we have nothing to do.

In connection with radiant heat (p. 138) we have mentioned the fact that light is of the same nature as radiant heat; and it is a familiar fact that when a body is *luminous*, i.e. is giving out light, it is usually radiating heat also. Our sources of heat are, in general, our sources of light, whether they are chemical, electrical, or other.

The glow-worm alone seems to have solved the problem of giving out light without heat. All our artificial sources of light fail very badly in this respect. It is easy to get a hot body to radiate heat without light; in these cases, however, a higher temperature will generally remedy the matter: a warm cinder becomes red-hot, and then white-hot as it becomes hotter. It is at present impossible to obtain light, without a large predominance of the invisible heat in attendance.



Drawn by Scriven Bolton, F.R.A.S., from photographs and sketches by Professor W. Harkness.

THE TOTAL SOLAR ECLIPSE OF AUGUST, 1914,

showing clearly the mysterious aureole, known as the corona, which surrounds the sun when the moon passes in front of it and cuts off its brilliant light. An eclipse of the sun is an excellent example of the rectilinear propagation of light (*see page* 267).

Sir Isaac Newton thought the light was due to the emission of an infinite number of luminous particles from the bright body, and many of the facts of light can be well explained on this theory. Nevertheless there are certain phenomena which it fails to interpret, and which are beautifully explained on the supposition that light is a form of wave-motion.

The main difficulty of this wave-theory of light lies in the conception of the *ether* which has to be created in our minds to carry the waves. The ether is not matter, yet is inseparable from it: it fills all space, yet cannot be made directly manifest to us. The waves travel in it at the enormous velocity of 186,000 miles a second: hence it must have in a high degree something akin to the property which in matter we call elasticity. With a density less than that of the thinnest air, it combines a rigidity greater than that of steel! Yet in modern physics it is the most real of phenomena; with its aid the facts of light are unified, and, most physicists would add, those of electricity too.

The light-waves which we conceive, then, are the carriers of energy from the luminous body across space. The waves themselves *are* the light. They are set up by vibrations within the molecules of matter in the ether. But they are themselves invisible: material objects alone become visible by their aid. If a strong beam of light is passed through a wooden box which has a side window, we can see the opposite side of the box, and the particles of dust show up the course of the light; but if the inside of the box is coated with a black paint and a layer of glycerine to hold the dust-particles, the interior of the box would look perfectly black, however strong the beam of light passing through it, because there are no material objects to reflect the light to the eye.

Moreover, it is because objects reflect unevenly and imperfectly the light falling on them that we see them at all. If all objects were perfect reflectors of light, we should not be able to distinguish one from the other, but merely have a general sensation of light.

When they fall on to material bodies, light-waves may be reflected, as we have just seen; or transmitted (through *transparent* bodies), or absorbed (by *opaque* bodies). Generally its fate is a mixture of two or all of these. Water, while transmitting most, reflects some of the light; polished metals reflect most, but absorb some also; and so on. During reflection or transmission, light, though it may be modified, still remains light; but after absorption the light-waves absorbed are destroyed as such, and changed into another form of energy—usually heat. Thus matter exerts an influence on the ether associated with it—a far-reaching influence which produces the phenomena of colour, among other things, which we shall study in a later lesson.

Light-waves, being as we have said carriers of energy, can be transformed into other forms of energy more useful than heat. Thus, light supplies the energy by which green plants make starch: it is the only form of energy that will perform that chemical action, which is fundamental to the life-processes of the plant. We may therefore say that without light there would be no living things. Again, light is the common form of energy which will reduce silver salts on the photographic plate, and thus makes possible the whole science of photography. These are examples of the chemical effects for which the energy carried by the waves of light is responsible.

Experiment 1.—Obtain a leaf from a lime tree which has been in the sunlight for some hours. Boil it in water for a few minutes, and then transfer it to a test-tube containing methylated spirits. Warm carefully if necessary. The green colour will gradually dissolve out of the leaf, and leave it a dirty white. Remove the blanched leaf to a dilute solution of iodine; after a few moments it will be found to have been stained blue, owing to the action of the iodine on the starch in the leaf.

Repeat the experiment on a leaf of a plant which has been kept in the dark for two days; no starch will be found.

2. Obtain a piece of photographer's "printing out paper"; place a key upon it, and expose it to the light. The paper not covered by the key will be darkened.

2. Rectilinear Propagation of Light.—Light spreads out from a luminous body in all directions in straight lines called *rays*. A ray of light, however, must not be understood as a real thing, but merely as a direction along which light

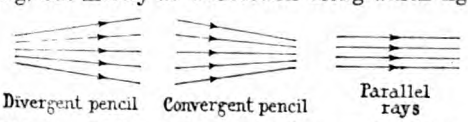


Fig. 1.—Light spreads out from a luminous body in straight lines called rays. A group of rays is known as a pencil; rays may be divergent, convergent or parallel.

appears to travel; nevertheless, it is very convenient to think of light in terms of rays.

A group of rays is spoken of as a *pencil* of rays. A pencil may be *divergent*, when the rays diverge from one point; or *convergent* when they converge to one point; or *parallel*. The rays of light from a very distant source, like the sun, are so little divergent that they are usually regarded as parallel. The light from a white wall comes under none of these descriptions: it is *diffused* or scattered light.

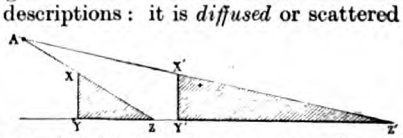


Fig. 2.—Explaining the geometrical relation between the shape of a shadow and the object which casts it.

An ordinary object is seen by diffused light, every point on it acting as a luminous centre, radiating light in all directions.

That light does travel in straight lines is suggested by the appearance of a beam of light in a dusty air. But it is shown conclusively by the appearance of *shadows*. The shape of a shadow is obviously related to the shape of the opaque object

which casts it; and the study of any given shadow will show that the relation is a geometrical one, dependent on the fact that light travels in rectilinear rays. Suppose A (Fig. 2) to be a source of light and X Y an opaque obstacle standing vertically. Draw the straight line A X Z to intersect the ground at Z. Then Y Z will represent the length of the shadow cast on the ground by X Y, if light travels in straight lines. Now if X Y is moved farther away from A, it is clear that, as it does so, the length of Y Z ought gradually to increase; and this, of course, is exactly what an observer does notice, as he walks along the street with a lamp behind him: his shadow lengthens as he walks away from the light.

In this reasoning, we have assumed A to be no more than a point, but the examination of the changed effect produced when A is enlarged to A B is even more convincing. Let X Y represent the opaque object, and let us suppose that the shadow is caught on a screen, placed parallel to the plane of X Y. Every point of A B will cast a shadow behind X Y, and it is evident that the shadow cast by A will not exactly coincide with that cast by any other point. Draw the shadows cast by the extreme points, A and B. Reference to Fig. 3 will now show that the shadow cast by the whole object is not entirely dark. Only a portion of it, the *umbra*, is in shadow to all parts of the source of light; on the edges of the umbra is a portion of partial illumination, known as the *penumbra*, which is in shadow to one end of the light, but not to the other. The presence and extent of the penumbra clearly results from the rectilinear propagation of light.

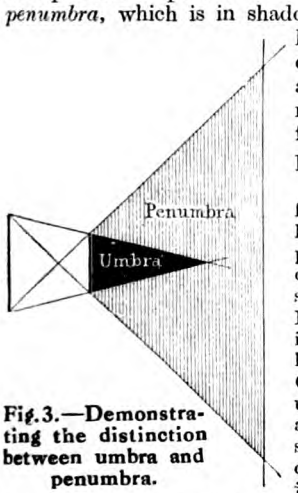


Fig. 3.—Demonstrating the distinction between umbra and penumbra.

To study this carefully, experimentally, let X Y be a circular piece of cardboard, and collect the shadow on a screen of cardboard. Perform the experiment in a dark room with a lamp burning steadily. Observe that both umbra and penumbra are circular when the screen is parallel to the obstacle, and the line joining the lamp to the centre of the obstacle is perpendicular to it. Otherwise, geometrical considerations demand that it should be elliptical. Study the shape of the shadow when the screen is more or less inclined. Also take the case figured in Fig. 3, when the opaque obstacle is smaller than the source of light. Here it will be noticed that the umbra is limited to a small cone behind the obstacle; if the screen be placed too far away, as in Fig. 3, only the penumbra will be caught on it.

Another method of observing these effects is to take a screen with a small hole in it. Place the screen so that the umbra falls on to the hole. On looking through the hole nothing will be seen. Move the screen slowly, still looking through the hole. When you get into the penumbra region, a portion of the flame will be seen, which grows larger and larger.

Eclipses of the sun and moon are excellent illustrations of the phenomena we have just discussed, and the fact that they can be foretold with so much exactitude is an impressive proof that the suppositions upon which the predictions are based are correct. One of these suppositions is the rectilinear propagation of light.

The sun is a large luminous body, and the moon a much smaller opaque one. Hence the moon casts a shadow like that figured in Fig. 4. If the umbra of the shadow falls on the earth at any point the sun will be totally eclipsed at that place; and at places where the penumbra falls there will be merely partial eclipse.

The distance of the earth from the moon is such that only a very small portion of the earth can perceive the eclipse; and the movement of the earth soon takes even that portion of it out of the shadow. Obviously the eclipse can only happen

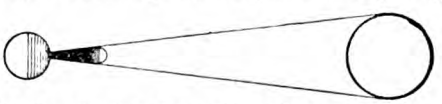


Fig. 4.—Total and partial eclipse of the sun: when the umbra falls on the earth the sun will be totally eclipsed; when the penumbra falls it will be partially eclipsed.

at new moon. It does not happen every month, because the plane of the moon's revolution does not coincide with that of the earth's revolution round the sun. Only when the moon is near one of the points of intersection of the planes is an eclipse of the sun possible, and its appearance there must also coincide with the time of new moon.

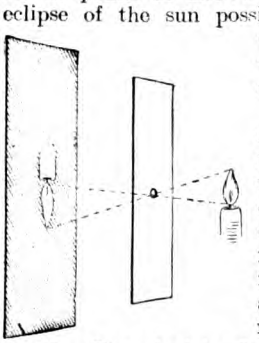


Fig. 5.—The principle of the pin-hole camera.

A total eclipse of the moon is produced when the moon passes into the umbra of the shadow cast behind the opaque earth by the sun. The moon is eclipsed when full, and the occurrence at any given locality is more frequent than a solar eclipse. It takes the moon several minutes to pass through the umbra. The eclipse does not occur at every full moon for the same reason that the eclipse of the sun fails at new moon. (*See also* Vol. I., pp. 424–427.)

A further simple proof that light travels in straight lines is furnished by the *pinhole camera*. Take an ordinary biscuit tin, and fit a piece of translucent glass into the end where the lid should be. Pierce a small hole in the centre of the bottom of the tin. Set the whole up to view an object as in a camera, using a cloth to keep out extraneous light. An inverted picture of the object will be observed on the glass screen. The size of the picture or *image*, as we call it, depends on the distance of the screen (Fig. 5). This can easily be studied in a dark room with a candle and cardboard screens.

E. W. E.

ELECTRICITY AND MAGNETISM.—I

Nature of Electricity.—What is Electricity and what is Magnetism? As yet, man is probably in no better a position to answer these questions than he is to give an explanation of the exact nature of Life. Various theories have been propounded, and when referring to these we must bear in mind that theories are merely attempted explanations to account for certain facts, and that they hold good as long as no new facts are discovered to upset them.

According to the earlier theories electricity was a fluid, or, more correctly, it consisted of two kinds of electrical fluid, called positive and negative respectively.

All substances were supposed to possess these fluids in exactly equal amounts, and, as the positive kind of electricity neutralised the negative kind, no electricity was apparent in things until the two kinds were separated by some means such as rubbing suitable materials together. Thus, when sealing-wax is rubbed with a piece of silk or flannel, the wax and the silk are found to possess the property of attracting small fragments of paper or other light articles. According to the Two-Fluid theory, the rubbing caused some of the positive fluid to go from the sealing-wax on to the silk, thus leaving an excess of negative electricity on the wax, and of positive on the silk.

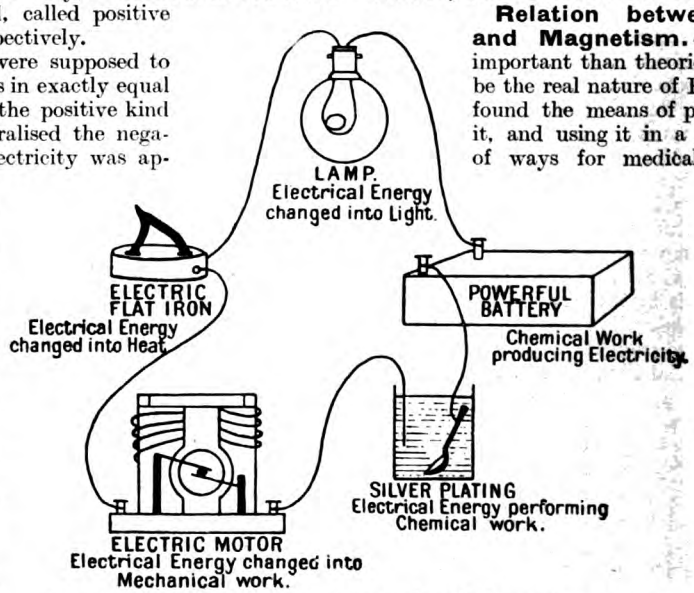


Fig. 1.—Diagram illustrating how electrical energy may be changed.

Another theory supposed that electricity consisted of one kind of fluid only, and that substances possessed a definite amount of it, and if by any process, such as rubbing, a substance could be made to contain more than its proper amount, it was said to be charged with positive electricity; but if it contained less than the normal quantity, then it was supposed to be charged with negative electricity. According to this theory, electricity passes from sealing-wax to silk, thus leaving the wax charged negatively and the silk positively.

Modern theories suppose that electricity is not a fluid at all, but consists of exceedingly small units termed electrons, of which there are considered to be two kinds, named positive and negative respectively and possessing different properties. The electrification of sealing-wax and silk is explained by supposing that the negative electrons pass from the silk to the wax, thus leaving an excess of positive electrons in the silk.

The theory of magnetism supposes that the attraction and repulsion between magnetic substances—steel, iron, etc.—is intimately connected with a certain arrangement of the very small particles composing lumps of these substances, and there is much evidence to support this view of the case, but the theory does not explain why iron or steel particles possess magnetic properties, neither does it tell us what that indefinable thing called magnetism really *is*.

To give an adequate definition of magnetism we should have to be able to explain what there is in iron or steel particles to cause attraction or repulsion even when they are arranged in a definite manner; and this is what we cannot do.

Relation between Electricity and Magnetism.—Facts are more important than theories. Whatever may be the real nature of Electricity, man has found the means of producing it, storing it, and using it in a very great variety of ways for medical, industrial, commercial, domestic and other purposes.

Similar remarks may be said of Magnetism; in fact, it is difficult to say which is of greater importance in the service of man, since the two are so intimately related that in the majority of useful applications one does not occur without the other.

Under certain conditions magnetism produces electricity, and that same electricity may be used to sustain and increase the magnetism that produced it. This is exactly what happens in a dynamo, a machine used for generating electricity for lighting, traction and other purposes. Certain essential parts of a dynamo consist of large masses of iron whose feeble residual magnetism produces an electric current in a moving coil of wire. This current, either part or the whole of it, is then used to increase the magnetic power of the iron masses, with the result that the electric current itself becomes stronger, and so the process goes on until powerful magnets and a very strong current are the results.

The ordinary electric bell serves as another illustration of the intimate relation between magnetism and electricity. A current of electricity flows along wires around pieces of iron. The iron becomes magnetised, and that very magnetism, in this case, stops the flow of electricity which produced it. An electric motor is a machine in which a strong electric current from an outside source produces powerful magnetism in certain parts of the motor, and this magnetism causes a movable portion of the machine to rotate.

Electricity and Energy.—Evidently electricity is capable of doing work, and this requires energy. Although electricity possesses the *energy of electrification*, electricity itself is not a form of energy. In order to make this point clear, we may make a brief reference to the human body. A man cannot be described as a form of energy, though he possesses energy by means of which he can do work. His energy is the result of chemical and physiological work that is being performed by the various organs of his body, particularly in the process of digestion, and in the absorption of oxygen by the blood in the act of breathing.

Similarly, the energy of electricity is, in the case of a current from a battery, the result of the chemical work being performed in the battery.

Again, take the case of a dynamo. The feeble magnetism of the masses of iron produces electricity in a *moving* coil of wire, and something capable of doing work, such as an engine, or falling water (as at Niagara), is required to move the coil of wire. No matter how powerful the magnets of a dynamo may be, there will be no electricity produced as long as the coil remains motionless.

The energy of electrification is the result of the work done in producing electricity. We might use the term electrical energy provided we understand that it does not mean electricity itself, just as the term man energy would not mean the man himself. Using the term in this sense, let us consider the connection between *electrical energy* and *heat* and *light*, which are actual forms of energy. When

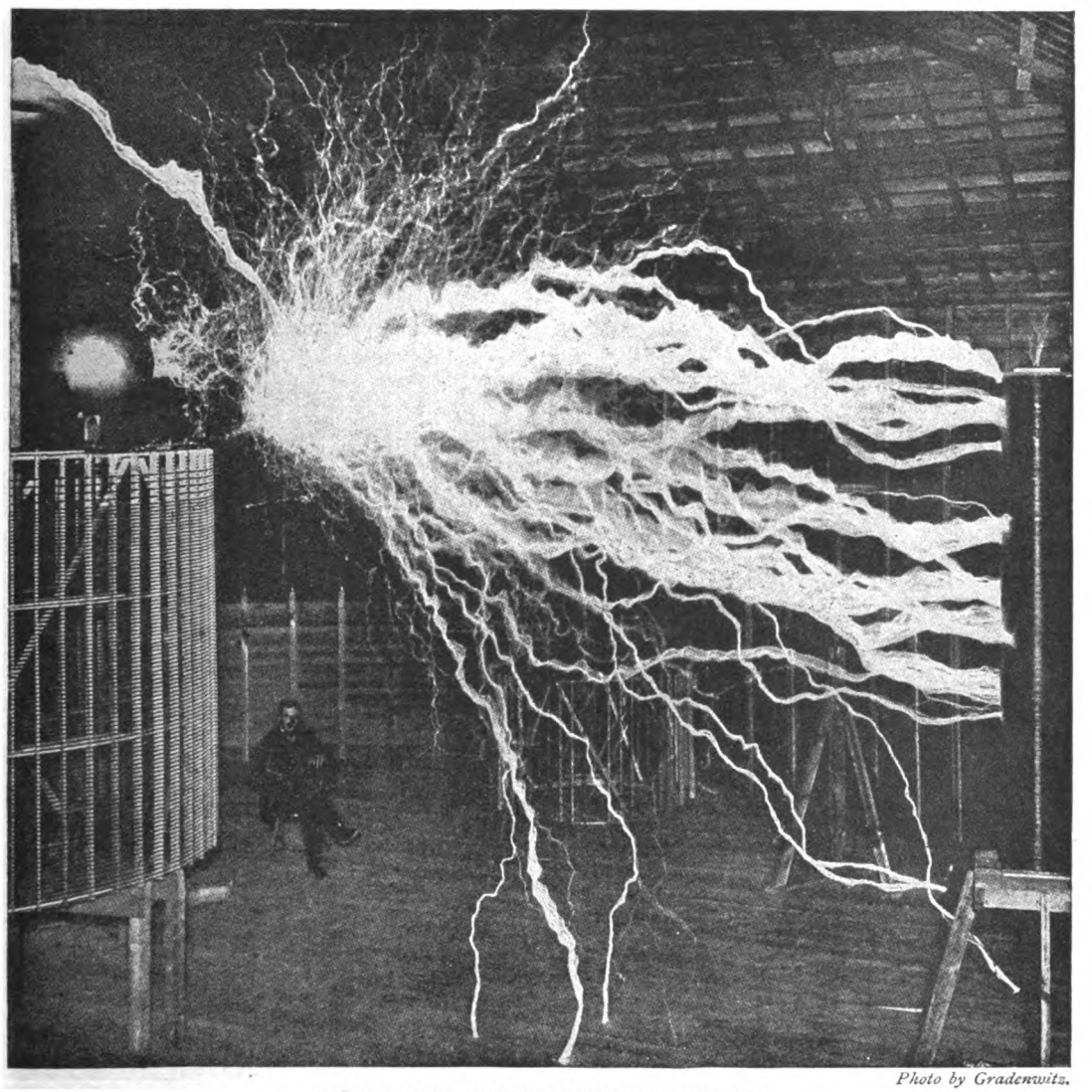
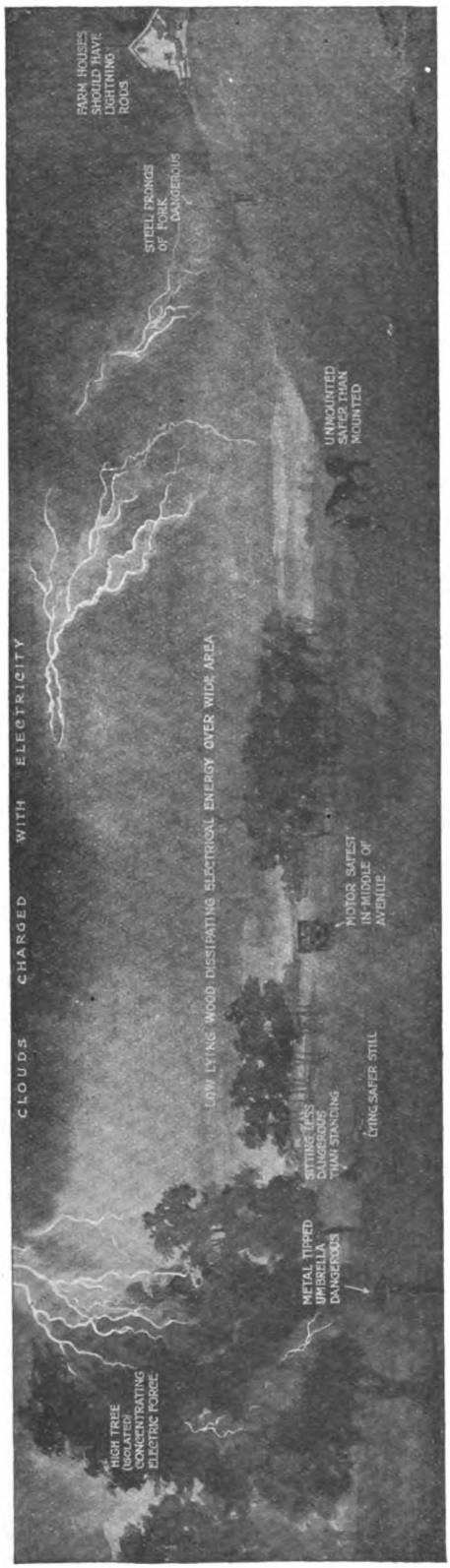


Photo by Gradenwitz.

A REMARKABLE ELECTRICAL DISCHARGE

photographed in the laboratory of the American scientist, Mr. Nikola Tesla, who claims that he could supply New York with power and light without the aid of wires.



A pictorial diagram illustrating the points of danger in a thunderstorm and suggesting precautions which can be taken. Lightning and thunder exhibit the phenomena of statical electricity on a gigantic scale.

an electric current flows along a thin wire or metal filament, as that in an ordinary electric lamp, the filament endeavours to resist the passage of electricity along it, and the electricity in overcoming this resistance renders the thin wire white-hot. Part of the electrical energy has been changed into the forms of energy called light and heat.

In the process the electric current has been much reduced in strength, and much of its energy has not been lost but has been changed in form.

The fact that energy cannot be destroyed, but may be changed from one form into another, is generally expressed by the use of the phrase *the conservation of energy*, and in later chapters we shall see how heat and light may be changed into electrical energy with the production of electricity.

Different Forms of Electricity.—Under different conditions there are different forms of electricity. We may describe one kind as flowing along a wire, and another kind as standing still on a piece of metal cut off from surrounding objects in such a way that the electricity cannot escape. Thus we have *current* electricity and *statical* (standing) electricity respectively, but the former is sometimes called Voltaic or Galvanic electricity after Volta and Galvani, early pioneers of the subject, and the latter is frequently termed "frictional electricity" on account of the rubbing methods sometimes used in producing it.

The existence of statical electricity has been known for thousands of years, and the ancients about the time 600 B.C. found that rubbed amber possessed the property of attracting light bodies, hence the name electricity, from *elektron*, the Greek word for amber. Magnetism also has been known for a very long time, the word magnet being derived from Magnesia in Asia Minor, where the natural magnetic oxide of iron was found.

Our knowledge of current electricity, the most useful form, dates from relatively recent times, and the invention of many electro-magnetic machines is a matter connected with the later part of the nineteenth century. In order to understand the chief differences between statical and current electricity we might make a limited comparison between electricity and water. Electricity that remains stationary on an isolated piece of metal is somewhat similar to a small mountain lake which would empty itself to the lowlands if a suitable channel for its descent were formed. The water of the lake is stationary, but in the event of a sudden breakdown of the land adjoining the lake there would be an instant and *complete* discharge of the water to a low level. Statical electricity is stationary and at a high electric level (potential), and should the air particles between the isolated piece of metal bearing the electricity and a neighbouring object break down there would be a sudden discharge of the electricity, the discharge making itself apparent as a spark, and the breakdown of the air particles making a sharp noise. Lightning and thunder exhibit these phenomena on a gigantic scale.

A current of electricity is somewhat similar to a river in which there is a constant flow of water from one level to a slightly lower level. To produce a flow there must be a difference of level, but this difference need not be very considerable, unless

there are numerous obstacles in the course of the river to be overcome. The water of a river may be made to do work such as turning a mill-wheel, but the sudden deluge formed when a lake empties itself into a chasm is of little use in the production of work, although the water may descend to a great depth in a remarkably short time. There would be no *continuous flow* of water.

Now, current electricity is that form of electricity that can be made to do work. There is a continuous flow along metallic wires which conduct the current just as the bed of a river conducts its waters. Water-level in the study of hydrostatics is very similar to potential in electricity—one is measured in feet, the other in volts; but these are matters that will be dealt with more adequately in later chapters. Current electricity, statical electricity, and magnetism can all be measured.

We can not only measure differences in potential, or that which causes electricity to flow, but we can measure the strength of the current and the amount of resistance which the current has to overcome. We must not carry the analogy between water and electricity too far. If river water meets obstacles in the shape of boulders or cataracts, the water dodges round and flows on without any loss of water, but if an electric current meets an obstacle in the form of a very thin wire, for instance, the electric current is diminished all along its course.

Scheme of Study.—Our scheme of study will be so arranged that a consideration of magnets and their properties will be taken first. Before working a few examples in magnetic measurements, we shall study the magnetism of the earth itself, since many calculations to determine the strength, etc., of magnets are based upon balancing the strength of the magnet against that of the earth's magnetism. Several chapters will then be devoted to the study of current electricity, since it is of such immense importance industrially, and is so intimately connected with magnetism.

In this section some of the most marvellous and useful modern inventions, such as X-rays and wireless telegraphy, will be described briefly. Lastly, statical electricity, its production by machines and simple operations, its measurement, and its occurrence in nature on a grand scale, will receive our attention.

L. M. P.

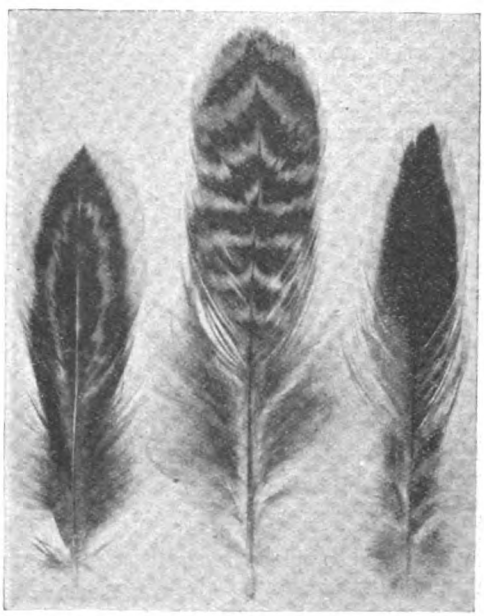
ZOOLOGY.—XII

LIKE the mammals birds have sprung from reptiles and even to-day have many points in common with their cold-blooded ancestors.

Birds and Reptiles

The resemblance between birds and reptiles is strongest, as we should expect to be the case, in the earliest stages of life, and thereafter grows rapidly less until bird and reptile become as wide as the poles asunder; the one, graceful and beautiful, wings its way rapidly through the air, the other, ungainly and repulsive, crawls sluggishly through the dust. Yet both bird and reptile develop from the same type of egg, and until the sixth day or so there is little to indicate the type to which the life within will conform—even the hard cap which protects the bill when the chick breaks his way through the shell is common to certain reptiles.

The scales on the foot, and, in certain species, the claw on the thumb of the wing, are tokens of reptilian ancestry of the bird throughout his life. Like certain characteristics of the "self-made" man they cannot be obscured by gorgeous plumage.



PARTRIDGE HEN'S HACKLE FEATHERS.

From left to right: Young hen's partially pencilled hackle; heavily pencilled hackle of 3-year-old hen; young hen's striped hackle.

His affinity to the mammal may be traced in his warm blood.

Structurally he shows many points of resemblance both to his mammalian cousin and his reptilian progenitor. There is, however, one characteristic in which the bird stands alone, and that is the clothing with which Nature has provided him. His feathers display what is possibly Nature's most wonderful effort to secure a means to an end. Not every type of bird continues to use its feathers in flight, but all types alike possess them. From the soft down next the skin to the long quills in wing and tail every feather beautifully overlaps its fellow, and assists to conserve the extraordinary heat which the rapid circulation of the blood diffuses through its body.

Again, the feathers though tough and warm are lightness itself; it is impossible to imagine a substance that could combine greater strength with such infinitesimal weight. Further, since the wing must of necessity be disproportionately great to the size of the body, Nature has designed the wing feathers in such a fashion that they present a flat surface to the air on the propelling stroke and a sharp edge on the return. The power of flight is to a large extent insured against accident to individual feathers by the fact that those lost or badly damaged are replaced almost immediately, even when the moulting season is only just passed.

It may be noticed at this point that the feathers are not evenly distributed over the body. One of the first to point out this curious fact was the German ornithologist, Nitsch, who showed conclusively that though the feathers cover the body they grow only upon certain areas which are separated by tracts of bare skin. By studying the size and form of the feather areas experts are enabled to place birds in their correct groups.

The wonderful colouring which tinges the plumage of many birds is caused either by the presence of actual pigment, by pigment overlaid with colourless structures, or by iridescence caused by light falling on the surface of a feather underlain by pigment. But however beautiful the colouring may be in the eyes of mankind, and however greatly it may be appreciated by the bird in the mating season, the possession of it is something very much akin to a calamity on account of the ceaseless persecution to which it gives rise. The selfish demands of Fashion have already brought about the extermination of many brilliant-tinted species and threaten in the near future to complete the extermination of others.

Upon the wonderful powers of sight possessed by such birds as the hawk, the vulture, the eagle and many other species it is unnecessary to dilate at any length. It is upon their keenness of vision or scent that birds usually depend for their food. Something, however, should certainly be said of the beak which will often be found to be specially modified to enable some particular form of food to be secured. Upon this subject we shall have more to say when we come to discuss particular species.

SKELETON OF A BIRD.

a, Vertebræ of the neck; *b*, collar bones, united in merry-thought; *c*, breast-bone; *d*, thigh-bone; *e*, leg-bone; *f*, toes.

Possibly, however, of all the characteristics of feathered creatures the one that appeals most strongly to the average man or woman is the power of song possessed by so many species in superlative degree. Even where the cry remains constant the careful listener will often perceive a variation in tone which to many has appeared to fill the place taken in human intercourse by words. If, as is almost certain, birds do actually communicate in rough fashion with one another it must be by the suggestion of a mood, since the power to describe a concrete fact is denied them. And it is this suggestion, we fancy, which is responsible for the effect, otherwise incomprehensible, exercised over the human imagination by such music as the song of the nightingale.

"Facts," says Darwin, "with respect to music and impassioned speech become intelligible to a certain extent, if we may assume that musical tones and rhythm were used by our half-human ancestors during the season of courtship, when animals of all kinds are excited, not only by love, but by the strong feelings of jealousy, rivalry, and triumph."

But to return to birds, it is generally held that the song, as distinct from bird-notes in everyday use, is in truth a love song, designed by the male to win or to maintain the admiration of his mate. It is only fair to say, however, that this view of the question is not held universally; many believe that the song is no more than the vocal expression of the bird's abundant vitality and joy in life. But whatever may be the motive that inspires it, the song itself is produced not by the tongue, as is often supposed, but by the peculiar formation by which the throat resembles a reed instru-

ment. The vocal apparatus of the finest songsters has been succinctly described as consisting of a long tube and a tiny membrane which vibrates under the transmission of air from the lungs. The throat which constitutes the tube of the instrument can be lengthened or shortened, widened or contracted, by muscular effort, thus making possible a variety of notes.

As we have already remarked, the skeleton of a bird shows many mammalian characteristics. The bones of the wings, for instance, are by no means dissimilar to those of the human arm save that the wrist-bones are practically absent. The entire structure, however, has been modified to combine a maximum of lightness and strength with a minimum of weight. The bones are of lighter material than those of mammals and in certain instances are hollow. It is exceedingly improbable, however, that the air chambers which to the number of nine or so connect with the lungs materially affect the question of weight, as has been suggested by some ornithologists.

The neck contains at least nine vertebræ, and in the case of long-necked birds many more. These vertebræ are very pliable, differing in this respect from those which form the backbone. The vertebræ of the tail are similar to those of the neck in that they are flexible. While the bones of different species show certain minor variations, flying and non-flying birds are sharply defined by the breast-bone, which, when heavy wing muscles have to be supported, contains a keel. In the case of non-flying birds the breast bone is practically flat.

Some of the most noted singing birds are the Song Thrush, Missel Thrush, Blackbird, Nightingale and Robin. They are to be found in almost all parts of Britain, and are to be heard even in gardens on the outskirts of towns.

The Nightingale arrives in April and its song is heard throughout May and ceases early in June. It sings not only at nighttime but also during the day. A. B.

EGRETS IN A FLORIDA CYPRESS FOREST.

The selfish demands of fashion have already brought about the extermination of several beautiful species of birds and threaten the extermination of others.

ANTHROPOLOGY.—V

An interesting form of the Forest Negro is the Congo Pygmy, a dwarf type still lingering in the forests of Equatorial Africa, and once perhaps more widely extended.

The Nilotic Negro

The type is not constant; taken out of the forest and enabled to live at ease in the wide and sunlit spaces, the Pygmy in two or three generations soon grows up into a Forest Negro of ordinary size and characteristic type.

The Nilotic Negro is so called because he is the characteristic and dominant race in the basin of the Upper Nile from 200 miles south of Khartum. He is characterised by unusually tall stature—some tribes containing many men of over seven feet in height, by legs that are disproportionately long, by a comelier face, often quite "Caucasian" in outline, and perhaps by a rather greater length and abundance of head-hair (when it is allowed to grow). On the other hand, the Nilotic Negro is markedly naked of skin, with very little hair to be seen either on face or body, whereas the Forest Negro is one of the hairiest of humans next to the Australoid and the European. The bodies of many Congo Pygmies are nearly covered with a fine yellowish down, in addition to a considerable growth of curly black hair, on chest, back, and limbs in the male; while there is some approach to whiskers in the females.

The West African and Central African Negroes of Forest are of mixed type, grow thick beards and whiskers, long moustaches, and have a good deal of hair on the body.

The mixture of these two forms, the Forest and the Nilotic Negro, together with the underlying Bushman element, and many incursions, historic and prehistoric, of the European and the Eur-Asiatic, have brought into existence the many Negro types at the present day. These vary greatly in stature from giants to pygmies, from hideous, very black-skinned people to pale-bronze men and women of handsome or even beautiful face outline; still, the Negro element is a very strong and a very recognisable one, and it requires many, many generations to pass before the negroid features are sufficiently eliminated to be in doubt.

From a photo lent to Sir H. H. Johnston.

A FULA OF NIGERIA.

A member of an ancient race inhabiting the northern parts of Negro Africa and possibly descended from the semi-Caucasian Neolithic population, which was gradually forced across the Sahara Desert by the incoming of stronger races from Europe.

Even at the present day there is a slight and very, very ancient negroid element in the Keltiberian and Iberian populations of Ireland, Scotland, Wales, France, Spain, Italy, and North Africa. The black belt round the Old World has been within the last three or four centuries extended right round the globe by the importation of the Negro into the West Indies, Central and South America. In northern South America, in eastern Central America, and in the West Indies, new and interesting racial types are arising. These are due to the intermixture between the Negro, the Amerindian, and the European.

This category of the principal racial types of Man at the present day deals with extreme forms, and does not cover sufficiently the numerous nations, tribes and peoples of intermediate type. Beginning our category of these, nearest to Britain, we have to enumerate the Tibu or Teda people of the Central Sahara and Libyan Deserts. These are obviously related in physical appearance to the Negroid Hamites of North-east Africa, but they probably have a greater proportion of Negro blood in their veins, derived from the ancient Negro populations of North Africa, which certainly preceded the various colonisations of the White man. Then farther west and south are the mysterious Fula of West and West-central Africa.

The pure-blooded Ful (their correct name for themselves is in the singular Pulo, and in the plural Fulbe) has a clear olive-tinted skin, a well-shaped nose and profile, thin lips, large eyes, no great prominence of the cheekbones, a full chin-beard in the male and head-hair which grows in kinky ringlets and is not even as curly as that of the "Fuzzy-wuzzy" of North-east Africa. The face is oval in shape and that of the women is often beautiful according to a European standard.

Fuzzy-Wuzzies

The Fula seem to be an ancient race in the northern parts of Negro Africa and possibly to be descended from the early White man, Neolithic population of North Africa, who were gradually forced across the western Sahara Desert by the incoming of whiter and stronger races from Europe. The Fula apparently passed down the Atlantic coast of the Sahara till they reached the valley of the Senegal and of the Niger, which they colonised very successfully, thence spreading in ancient and modern times across the northern Sudan to the vicinity of Darfur.

The Fuzzy-wuzzies of North-east Africa (Bisharin, Hadendaua, Danákil, Somali, and Gala) are obviously an intermediate race or a hybrid between the average type of Mediterranean white man and ancient Negro (and even Bushman) peoples of North-east Africa. Further interminglings on their part with the Negro stock have produced the Masai and the tall, even gigantic, long-legged Nilotic Negroes, the race influence of which extends westwards to the Buduma of Lake Chad.

It is believed that at one time these dark-skinned Hamites (mainly white man in racial type and in culture) had spread right across Abyssinia and Egypt to the Tripolitaine and Mauretania, and that they constitute physically the main stock of the North African people at the present day. They brought with them from Western Asia their Hamitic speech (which is allied fundamentally to the

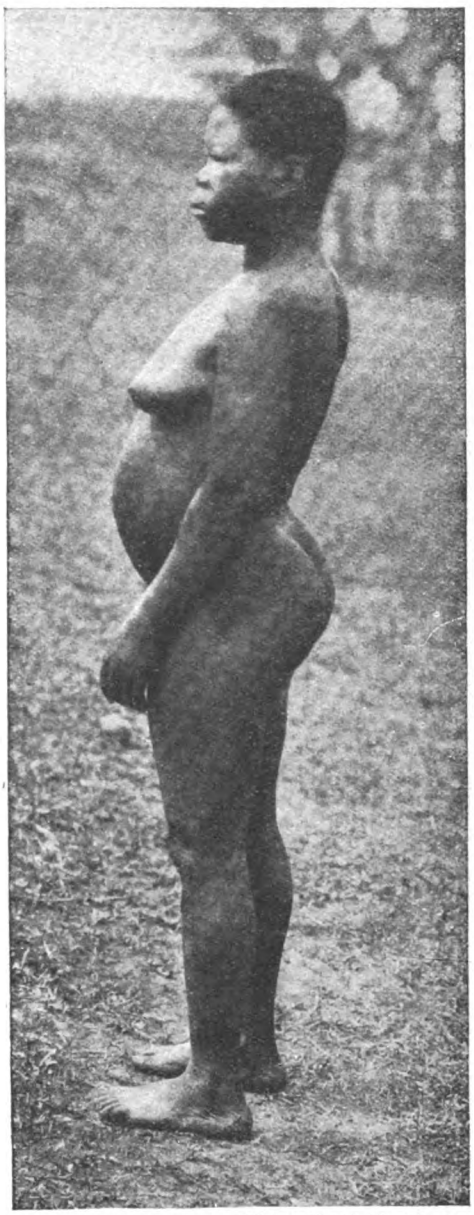


Photo: Sir H. H. Johnston.

NEGRO PYGMY WOMAN.

Taken out of the forests of Equatorial Africa and enabled to live in wide, sunlit spaces, the Pygmy grows in two or three generations into a Negro of ordinary size.

Photos: The Ethnological Survey of the Madras Province.

TYPES OF DRAVIDIANS FROM SOUTHERN INDIA.

Dravidian is properly the name of an important family of Baluchistan and of Southern India; but it is also used to cover the dark-skinned somewhat negroid natives of India who are chiefly associated with Dravidian types of language.

Semitic family); and this they imparted to their successors and conquerors in North Africa, the early Libyans or Iberians, who in their turn swept eastwards across Egypt and perhaps even into Abyssinia, where they seem to have left their traces in the types dwelling on the high mountains.

The Abyssinians are a very composite people—Libyan, Hamitic, Semitic, Negroid and Negro in race elements. In the far south of the Ethiopian dominions the tribes become more and more Negroid in complexion and affinities, and there are said to be pygmy peoples of Bushman characteristics (in physique, if not in language), just as there are distinct traces of a Bushman type of language (the Sandawi) in Equatorial East Africa, to the south-east of the Victoria Nyanza.

The Bahima aristocracy of Equatorial Africa strongly resembles the Gala race in its bodily characteristics, except that the hair is slightly more curly and like that of the Negro. There are also in the Bahima faces traits which irresistibly recall the carven features of the dynastic Egyptians.

Madagascar Types

Somewhat similar to the Bahima of the Uganda Protectorate and the north Tanganyika regions are the aristocratic type of Mañgbettu and Nyam-nyam (Azande) in the Central Sudan; though amongst the Nyam-nyam there is a separate and distinct round-headed type; not easily accounted for, since over nearly the whole part of the African continent, except in the extreme south (where the Bushman type predominates), the skull form is dolichokephalous.

Perhaps, the round-headed Azande may be in part descended from the round-headed "Strandlooper" type, the ancient race of South Africa with broad skulls and good brain capacity—a race which obviously came from the Mediterranean basin and must have left many colonies behind in its wanderings southwards.

The aristocratic type of Negroid, with finely carved face features, a somewhat lighter skin and longer head-hair, can be traced from east to west right across Equatorial Africa. It reappears in the Bushongo of the central Congo and in some of the Bantu tribes of Northern Congoland, in the Fang and other peoples of the Cameroons, in the Arõ of the eastern portion of the Niger delta, and in the Yoruba to the west of the Lower Niger.

In Madagascar there are curious racial types and race problems as yet incompletely solved. We have here over the whole of this large island peoples of varying type, but all speaking dialects of the Malagasi language. This is a speech of Malay origin, that is to say, related to the parent languages of the Malay Archipelago and Polynesia.

Some of the Madagascar tribes, like the Hova of the central plateau, can scarcely be distinguished in appearance from the Javanese. Others again are more than half Negro and are clearly related on one side to the Bantu populations of East Africa. It would seem as though this great island had been colonised by adventurous Mongoloid seafaring peoples from Sumatra, Java, and possibly Timor, who were not entirely free from Negroid intermixture when they left their original homes in Equatorial Asia, for they had there been in contact for ages with the Oceanic Negro.

Photo: Royal Anthropological Institute

OCEANIC NEGRO.

The Asiatic Negro may be divided into five sections:—(1) those of Southern India; (2) the Andaman Islanders; (3) the Negrillos of the Malay Archipelago; (4) the Papuans of New Guinea; and (5) the Oceanic Negroes of the Solomon Islands.

Some time after they had reached and colonised Madagascar, they got into touch with the first Arab and Indian seafaring explorers who, perhaps more than 2,000

years ago, had begun to open up relations with the east coast of Africa. Apparently they carried on an early slave trade in that region, and not only conveyed large numbers of negroes up the East African coast to Arabia and the Red Sea, but across the Moçambique Channel to their colonies on the west, north, and north-east of Madagascar.

This slave trade once begun scarcely came to a close until a few years ago. In this way the population of Madagascar became in some tribes so deeply infused with Negro blood that it is at the present time almost more African in type than Asiatic. Yet it speaks throughout the large island only one type of Malay language.

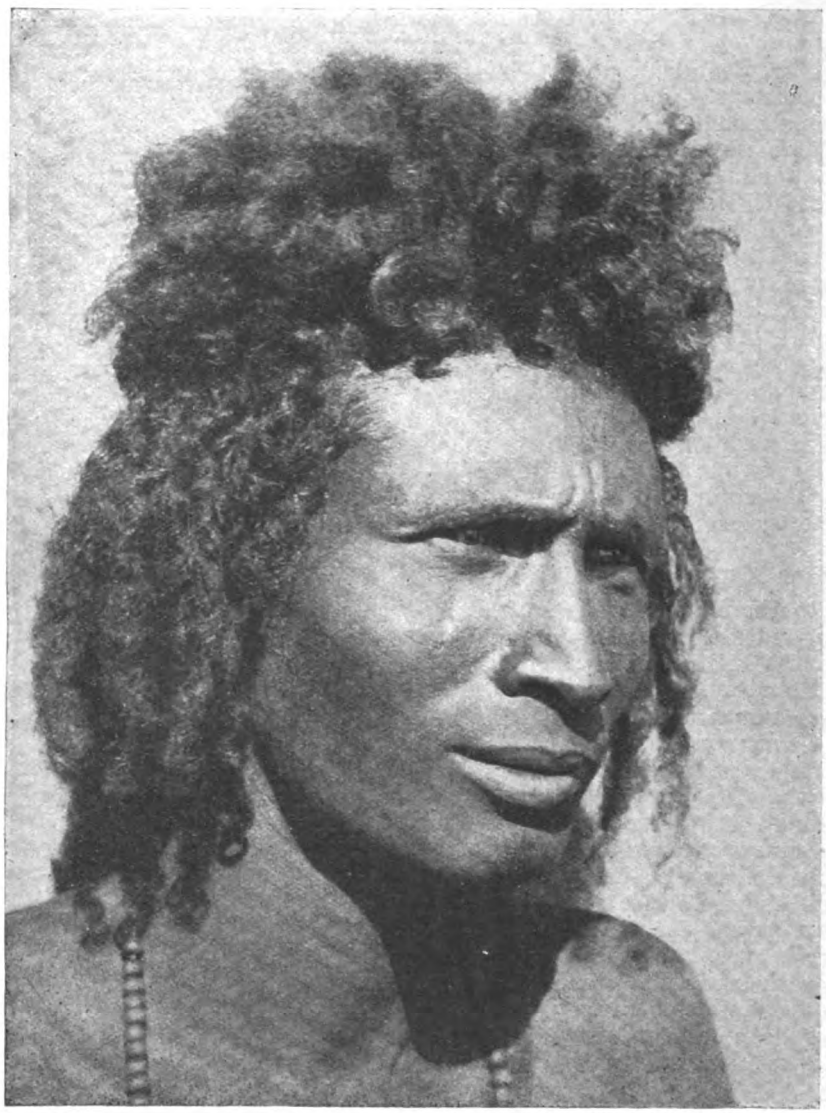


Photo purchased by Sir H. H. Johnston.

A TYPICAL HAMITE.

The Hamites, a dark-skinned people of North-East Africa, but mainly White men in racial type and culture, at one time spread right across from Abyssinia and Egypt to Morocco, and constitute physically the main stock of the N. African people to-day.

In Arabia itself it is customary to speak of the indigenous tribes as "Semitic." This means that they all speak languages of a Semitic type. But their physical characteristics are by no means uniform. In the west and north of Arabia the people belong more or less to the Mediterranean type of man, with evidences here and there of a more northern, almost Nordic type (Syria in past ages has been colonised over and over again by the northern type of White man). In Eastern Arabia there is evidence of the former existence of an indigenous Negroid people belonging no doubt to the Asiatic Negro stock. In the south and centre of Arabia the population often resembles closely in appearance the Hamites of North-east Africa, and is no doubt of common origin.

In the great peninsula of India there are several indeterminate race types not coming distinctly within the limits of any of the great, clearly-marked categories of White man, Mongol and Negro. Obviously, India was once populated by dark-skinned Australoids

akin to those of Australia at the present day, and by the Asiatic and Oceanic Negro (two distinct negro types, the latter having very much more marked brow-ridges and being without the very characteristic skin odour of his African cousin). Then came many Mongol invasions from the north-east, which brought into the peninsula the peoples of the coarse, straight, black hair, projecting cheekbones, narrow eyes obliquely set, small narrow noses and yellow skins.

After that arrived what we may style the Dravidian race, with its characteristic class-languages distantly related to those of the Caucasus. This Dravidian type is very evident at the present day in Persia, Baluchistan and West-central Asia. It is a handsome race, with a great abundance of hair on the head and body (hair that is rather inclined to curl), of nearly white skin, and well shaped prominent nose, closely allied to the Iberian of the Mediterranean and the Caucasus, yet with certain differences. These Dravidians apparently preceded the Nordic Aryan who was to have an ultimate and profound influence over the fate of India.

The Dravidian Type

The Dravidians permeated the whole Indian peninsula and their mixed descendants subsequently crossed to Ceylon, which we may presume then to have been inhabited only by the Australoids, who survive under the form of the modern Vedda. The Dravidians even may have been in part the ancestors of that mysterious Indonesian race which passed from India through Burma and Siam into Cochin China and the Malay Peninsula, Sumatra, and some of the great Malay Islands, and which was the chief source of the energetic, far-reaching Polynesian mixed type which has colonised so much of the Pacific from New Zealand to Easter Island and the Marquezas.

Following on the Dravidian domination of India came the Aryan. We may well suppose, without conflict with any of the main facts as yet discovered, that the Aryans were originally Nordic, fair-haired, grey-eyed or blue-eyed men with absolutely white skins, who arose in Neolithic times somewhere in Central Russia or in the once better-watered countries of Turkestan (Western Asia). Here they may even have originated the Neolithic civilisation and subsequently have discovered the use of iron.

Overflowing from their original Eur-Asiatic home, the Aryans passed down through Afghanistan into Northern Persia on the one hand, and into North-west India on the other. In course of time they had founded kingdoms and castes of superior white-skinned peoples over the whole of Northern India to the mouth of the Ganges. Perhaps they sent adventurers and colonists,

Photo: Sir H. H. Johnston.

SEMITIC ARAB.

The Arab, though commonly called "Semitic," belongs really to various racial types—Mediterranean, Hamite and Armenoid.

even, to civilise southern Indo-China and Java, to supplement the White element in Melanesia and to impart further energy to the colonisation of the Pacific.

At any rate, they made India what it is at the present day, a peninsula imprinted more strongly with the caste system—humanity divided into water-tight compartments in regard to racial elements—than any other region of the earth. H. H. J.

Continued from page 224.

LANGUAGES:

Contributors:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A.[Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).

LATIN.—XIII

THE PRINCIPAL PARTS OF THE VERB

IN order to conjugate a verb you must know :—

(1) The infinitive, which shows the characteristic vowel and consequently the conjugation to which it belongs ; (2) the perfect indicative active, which gives the base for all the perfect tenses ; (3) the supine, which tells you what the past participle is and forms a key to the compound tenses of the passive ; (4) the first person singular of the present indicative, which enables you to distinguish verbs conjugated like **capio** from others of the third declension.

In the following list are given verbs of the first, second, and fourth conjugation forming their perfect and supine differently from the regular model (i.e. of ămō, mŏnĕō, and audiō) :—

First Conjugation

1. Reduplicated perfect :—

Present.	*Perfect.*	*Supine.*	*Infinitive.*	
stō	stĕtī	stātum	stāre	*stand.*
circum-stō	circum-stĕtī		circum-stārĕ	*stand around.*
constō	constĭtī	constātum (or -ātum)	constāre	*stand firm.*

2. Perfect formed by lengthening stem-vowel :—

jŭvō	jūvī	jūtum	jūvāre	*help.*
lăvō	lāvi (or lăvīvī)	lāvātum lautum (or lōtum)	lăvāre	*wash.*

3. Perfect formed by adding s :—

None.

4. Perfect formed by adding v preceded by a long vowel :—

pōtō	pōtāvī	pōtum (or pōtātum)	pōtāre	*drink.*

Pōtō is cited only on account of its irregular supine. This is the ordinary method of forming the perfect in this declension.

5. Perfect formed by adding u :—

crĕpō	crĕpŭī	crĕpĭtum	crĕpāre	*rattle.*
cŭbō	cŭbŭī, rarely cubāvī	cŭbĭtum	cŭbārĕ	*lie down.*
dĭmĭcō	dŏmŭī	dŏmĭtum	dŏmārĕ	*tame.*
dŏmō	dĭmĭcui (or dĭmicāvi)	dĭmĭcātum	dĭmĭcārĕ	*fight.*
frĭcō	frĭcŭī	frictum (or frĭcātum)	frĭcāre	*rub.*
mĭcō	mĭcŭī		mĭcārĕ	*quiver, flash.*
plĭcō	plĭcāvī (or plĭcŭī)	plĭcātum (or plĭcĭtum)	plĭcārĕ	*unfold.*
rĕsŏnō	resonui (or resonāvi)		resonāre	*resound.*
sĕcō	sĕcŭī	sectum	sĕcārĕ	*cut.*
sŏnō	sŏnŭī	sŏnĭtum	sŏnārĕ	*sound.*
tŏnăt	tŏnŭī	tŏnĭtum	tŏnārĕ	*thunder.*
vĕtō	vĕtŭī	vĕtĭtum	vĕtārĕ	*forbid.*

6. Perfect base the same as present base :—

None.

Second Conjugation

1. Perfect formed by reduplication :—

Present.	*Perfect.*	*Supine.*	*Infinitive.*	
mordĕō	mŏmordī	morsum	mordērĕ	*bite.*
pendĕō	pĕpendī	pensum	pendērĕ	*hang* (intr.).
spondĕō	spŏpondī	sponsum	spondērĕ	*promise.*
tondeō	tŏtondī	tonsum	tondērĕ	*shear.*

2. Perfect formed by lengthening stem-vowel :—

căvĕō	cāvī	cautum	cavērĕ	*beware, guard against.*
făvĕō	fāvī	fautum	favērĕ	*favour, support.*
fŏvĕō	fōvī	fōtum	fŏvērĕ	*foster.*
mŏvĕō	mōvī	mōtum	mŏvērĕ	*move* (tr.)
păvĕō	pāvī		păvērĕ	*tremble.*
possĭdĕō	possēdī	possessum	possĭdērĕ	*possess.*
sĕdĕō	sēdī	sessum	sedērĕ	*sit.*
vĭdĕō	vīdī	vīsum	vidēre	*see.*
vŏvĕō	vōvī	vōtum	vovērĕ	*vow.*

And so all compounds of sĕdĕō except circumsĕdĕō and sŭpersĕdĕō, which are declined like sĕdĕō.

3. Perfect formed by adding s :—

augĕō	auxī	auctum	augērĕ	*increase* (tr.).
frīgĕō	frixī		frīgērĕ	*to be cold.*
haerĕō	haesī	haesum	haerērĕ	*stick* (intr).
indulgĕō	indulsī		indulgērĕ	*give way (to).*
jŭbĕō	jussī	jussum	jubērĕ	*command.*
lūcĕō	luxī		lucērĕ	*shine.*
lūgĕō	luxī	luctum	lugērĕ	*mourn.*
mānĕō	mansī	mansum	manērĕ	*remain.*
rīdĕō	rīsī	rīsum	ridērĕ	*laugh.*
suādĕō	suasī	suasum	suadērĕ	*advise.*
torquĕō	torsī	tortum	torquērĕ	*twist.*
urgĕō	ursī		urgērĕ	*press.*

4. Perfect formed by adding v preceded by a long vowel :—

cĭĕō	cīvī	cītum	cīērĕ	*set in motion.*
dēlĕō	dēlēvī	delētum	dēlērĕ	*blot out.*
flĕō	flēvī	flētum	flērĕ	*weep.*
nĕō	nēvī	nētum	nērĕ	*spin.*
com-plĕō	complēvī	complētum	complērĕ	*fill.*

So also explĕō, *fill up*; rĕplĕō, *fill again*; supplĕō, *fill up.*

5. Perfect formed by adding u :—

ab-ŏlĕō	ăbŏlēvī	ăbŏlĭtum	ăbŏlērĕ	*destroy.*
censĕō	censŭī	censum	censērĕ	*assess.*
dŏceō	docŭī	doctum	docēre	*teach.*
ferveō	fervŭī or fervī		fervērĕ	*boil* (intr.).
miscĕō	miscŭī	mixtum or mīstum	miscērĕ	*mix* (tr.).
rĕtĭnĕō	rĕtĭnŭī	rĕtentum	rĕtĭnērĕ	*retain.*
tĕnĕō	tĕnŭī	tentum	tĕnērĕ	*hold.*
torrĕō	torrŭī	tostum	torrērĕ	*roast.*

6. Perfect base the same as present base :—

prandĕō	prandī	pransum	prandērĕ	*lunch.*
stridĕō	strīdī		stridērĕ	*screech.*

The following have a deponent perfect :—

Present.	*Perfect.*	*Inf.*	
audĕō	ausŭs sum	audērĕ	*dare.*
gaudĕō	gāvīsŭs sum	gaudērĕ	*rejoice.*
lĭbĕt	lĭbŭĭt (or lĭbĭtum est)	lĭbērĕ	*it is pleasing* (impers.).
lĭcĕt	lĭcŭĭt (or lĭcĭtum est)	lĭcērĕ	*it is lawful* (impers.).
pŭdĕt	pŭdŭit (or pudĭtum est)	pudērĕ	*it makes ashamed* (impers.).
sŏlĕō	sŏlĭtŭs sum	sŏlērĕ	*be accustomed.*
taedĕt	taesum est	taedēre	*it wearies* (impers.).

Third Conjugation

1. Perfect formed by reduplication :—

Present.	*Perfect.*	*Supine.*	*Infinitive.*	
cădō	cĕcĭdī	cāsum	cădĕrĕ	*fall.*
concĭdō	concĭdī		concĭdĕrĕ	*fall.*

All the other compounds, e.g. occĭdō, *fall down*, and rĕcĭdō, *fall back*, have supines occāsum and rĕcāsum.

caedō	cĕcīdī	caesum	caedĕre	*cut.*
occīdō	occīdī	occīsum	occīdĕrĕ	*kill.*
cănō	cĕcĭnī	canfum	cănĕrĕ	*sing.*
con-cĭnō	concĭnŭī		concĭnĕrĕ	*sing in concert.*
currō	cŭcurrī	cursum	currĕrĕ	*run.*
discō	dĭdĭcī		discĕrĕ	*learn.*
fallō	fĕfellī	falsum	fallĕrĕ	*deceive.*
parcō	pĕpercī		parcĕrĕ	*spare* (intr.).
părĭō	pĕpĕrī	partum	parĕrĕ	*produce.*
pellō	pĕpŭlī	pulsum	pellĕrĕ	*drive back, expel.*
pendō	pĕpendī	pensum	pendĕrĕ	*weigh, pay.*
poscō	pŏposcī		poscĕrĕ	*demand.*
dēposco	dēpŏposcī		dēpŏposcĕrĕ	*demand.*
pungō	pupŭgī	punctum	pungĕrĕ	*prick.*
sistō	stĭtī	stătum	sistĕrĕ	*cause to stand.*
consistō	constĭtī	constĭtum	consistĕrĕ	*stand still.*
	Other compounds as consistō.			
tangō	tĕtĭgī	tactum	tangĕrĕ	*touch.*
attingō	attĭgī	attactum	attingĕrĕ	*touch, handle.*
tendō	tĕtendī	tentum	tendĕrĕ	*stretch.*
tundō	tŭtŭdī	tunsum or tūsum	tundĕrĕ	*thump.*

Compounds of dō, dĕdī, dātum, dārĕ *give* :—

ab-dō	abdĭdī	abdĭtum	abdĕrĕ	*put away.*
crēdō	crēdĭdī	crēdĭtum	crēdĕrĕ	*believe.*
vendō	vendĭdī	vendĭtum	vendĕrĕ	*sell.*
abscondō	abscondī	abscondĭtum	abscondĕrĕ	*conceal.*

Circumdō, *to put round*, is an exception, following the model of the irregular dō, dĕdī, dātum, dărĕ, *give.*

2. Perfect formed by lengthening stem-vowel :—

ăgō	ēgī	actum	ăgĕrĕ	*drive, do.*
cōgō	cŏēgī	cŏactum	cōgĕrĕ	*compel.*
căpĭō	cēpī	captum	căpĕrĕ	*take.*
accĭpĭō	accēpī	acceptum	accĭpĕrĕ	*received.*
ĕdō	ēdī	ēsum or esse	ĕdĕrĕ	*eat.*
ĕmō	ēmī	emptum	ĕmĕrĕ	*buy.*
facĭō	fēcī	factum	făcĕrĕ	*make.*
affĭcĭo	affēcī	affectum	affĭcĕrĕ	*affect.*
fŏdĭō	fōdī	fossum	fōdĕrĕ	*dig.*
frangō	frēgī	fractum	frangĕrĕ	*break.*
fŭgĭō	fūgī	fŭgĭtum	fŭgĕrĕ	*flee.*
fundō	fūdī	fūsum	fundĕrĕ	*pour.*
iăcĭō	iēcī	iactum	iăcĕrĕ	*throw.*
abĭcĭō	abĭecī	abiactum	abĭcĕrĕ	*throw away.*
lĕgō	lēgī	lectum	lĕgĕrĕ	*pick, read.*
linquō	līquī		linquĕrĕ	*leave.*
pangō	pēgī	pactum	pangĕrĕ	*fasten.*
rumpō	rūpī	ruptum	rumpĕrĕ	*break.*
vincō	vīcī	victum	vincĕrĕ	*conquer.*

In compounds of iăcĭō the vowel of the

prefix is regarded as long by position, even when the consonantal I has disappeared.

Key to Exercise 12

1. I was about to have this very excuse. 2. If we follow nature as guide we shall never go astray. 3. The consul binds himself not to fail the senate and the commonwealth. 4. The thing was done with manly courage but puerile counsel. 5. A mighty deed was performed that day, I know not whether the greatest throughout that war. 6. I desire to be good from this day forward. 7. The Helvetii are by the nature of the land shut in on every hand, on one side by the River Rhine, on the other by the Jura Mountains, and on a third by Lake Leman. 8. You see that he accomplished many things and we attempt many. 9. The minds of youths, being flexible and yielding on account of their age, are easily seduced.

1. Sabinus suos hortatus, cupientibus signum dat. 2. Suum cum Scipione honorem partitur. 3. Horae quas exspectabamus longae videbantur. 4. Rex mihi sapientissime loqui videbatur. 5. Multae res ad hoc consilium Gallos hortabantur. 6. Qui utuntur vino vetere sapientes puto. 7. Di tibi divitias dederant artemque fruendi. 8. Oculi saepissime mentiuntur. 9. Id mihi duabus de causis instituisse videntur. 10. Quid ego plura dicam? E. A. B.

FRENCH.—XIII

FOUR REGULAR CONJUGATIONS (*continued*).

III.—RECEVOIR, *to receive*

recevoir, recevant, reçu, je reçois, je reçus

Indicative Mood

PRESENT	PAST INDEFINITE
je reçois, *I receive.*	j'ai reçu, *I have received.*
tu reçois	tu as reçu
il reçoit	il a reçu
nous recevons	nous avons reçu
vous recevez	vous avez reçu
ils reçoivent	ils ont reçu
IMPERFECT	PLUPERFECT
je recevais, *I was receiving.*	j'avais reçu, *I had received.*
tu recevais	tu avais reçu
il recevait	il avait reçu
nous recevions	nous avions reçu
vous receviez	vous aviez reçu
ils recevaient	ils avaient reçu
PAST DEFINITE	PAST ANTERIOR
je reçus, *I received.*	j'eus reçu, *I had received.*
tu reçus	tu eus reçu
il reçut	il eut reçu
nous reçûmes	nous eûmes reçu
vous reçûtes	vous eûtes reçu
ils reçurent	ils eurent reçu
FUTURE	FUTURE ANTERIOR
je recevrai, *I shall receive.*	j'aurai reçu, *I shall have received.*
tu recevras	tu auras reçu
il recevra	il aura reçu
nous recevrons	nous aurons reçu
vous recevrez	vous aurez reçu
ils recevront	ils auront reçu

Conditional Mood

PRESENT	PAST
je recevrais, *I should receive.*	j'aurais reçu, *I should have received.*
tu recevrais	tu aurais reçu
il recevrait	il aurait reçu
nous recevrions	nous aurions reçu
vous recevriez	vous auriez reçu
ils recevraient	ils auraient reçu

Imperative Mood

reçois, *receive* (thou).
qu'il reçoive, *let him receive.*
recevons, *let us receive.*
recevez, *receive* (ye).
qu'ils reçoivent, *let them receive.*

Subjunctive Mood

PRESENT	PERFECT
que je reçoive, *that I may receive.*	que j'aie reçu, *that I may have received.*
que tu reçoives	que tu aies reçu
qu'il reçoive	qu'il ait reçu
que nous recevions	que nous ayons reçu
que vous receviez	que vous ayez reçu
qu'ils reçoivent	qu'ils aient reçu
IMPERFECT	PLUPERFECT
que je reçusse, *that I might receive.*	que j'eusse reçu, *that I might have received.*
que tu reçusses	que tu eusses reçu
qu'il reçût	qu'il eût reçu
que nous reçussions	que nous eussions reçu
que vous reçussiez	que vous eussiez reçu
qu'ils reçussent	qu'ils eussent reçu

Infinitive Mood

PRESENT	PAST INDEFINITE
recevoir, *to receive.*	avoir reçu, *to have received.*
PRESENT PARTICIPLE	PAST PARTICIPLE
recevant, *receiving.*	reçu, reçue, *received.*

IV.—VENDRE, *to sell*

vendre, vendant, vendu, je vends, je vendis

Indicative Mood

PRESENT	PAST INDEFINITE
je vends, *I sell.*	j'ai vendu, *I have sold.*
tu vends	tu as vendu
il vend	il a vendu
nous vendons	nous avons vendu
vous vendez	vous avez vendu
ils vendent	ils ont vendu
IMPERFECT	PLUPERFECT
je vendais, *I was selling.*	j'avais vendu, *I had sold.*
tu vendais	tu avais vendu
il vendait	il avait vendu
nous vendions	nous avions vendu
vous vendiez	vous aviez vendu
ils vendaient	ils avaient vendu

PAST DEFINITE	PAST ANTERIOR
je vendis, *I sold.*	j'eus vendu, *I had sold.*
tu vendis	tu eus vendu
il vendit	il eut vendu
nous vendîmes	nous eûmes vendu
vous vendîtes	vous eûtes vendu
ils vendirent	ils eurent vendu

FUTURE	FUTURE ANTERIOR
je vendrai, *I shall sell.*	j'aurai vendu, *I shall have sold.*
tu vendras	tu auras vendu
il vendra	il aura vendu
nous vendrons	nous aurons vendu
vous vendrez	vous aurez vendu
ils vendront	ils auront vendu

Conditional Mood

PRESENT	PAST
je vendrais, *I should sell.*	j'aurais vendu, *I should have sold.*
tu vendrais	tu aurais vendu
il vendrait	il aurait vendu
nous vendrions	nous aurions vendu
vous vendriez	vous auriez vendu
ils vendraient	ils auraient vendu

Imperative Mood

vends, *sell* (thou).
qu'il vende, *let him sell.*
vendons, *let us sell.*
vendez, *sell* (ye).
qu'ils vendent, *let them sell.*

Subjunctive Mood

PRESENT	PERFECT
que je vende, *that I may sell.*	que j'aie vendu, *that I may have sold.*
que tu vendes	que tu aies vendu
qu'il vende	qu'il ait vendu
que nous vendions	que nous ayons vendu
que vous vendiez	que vous ayez vendu
qu'ils vendent	qu'ils aient vendu

IMPERFECT	PLUPERFECT
que je vendisse, *that I might sell.*	que j'eusse vendu, *that I might have sold.*
que tu vendisses	que tu eusses vendu
qu'il vendît	qu'il eût vendu
que nous vendissions	que nous eussions vendu
que vous vendissiez	que vous eussiez vendu
qu'ils vendissent	qu'ils eussent vendu

Infinitive Mood

PRESENT	PAST INDEFINITE
vendre, *to sell.*	avoir vendu, *to have sold.*
PRESENT PARTICIPLE	**PAST PARTICIPLE**
vendant, *selling.*	vendu, vendue, *sold.*

VOCABULARY

apercevoir, *to see, perceive.*
à travers, *across, awry.*
aussitôt, *at once.*
cacher, *to conceal.*
chez moi,-vous, n., *at my house, your house,* etc.
le compagnon, *the companion.*
de bonne heure, *early.*
devant, *in front of.*
devoir, *to owe, ought.*
dire, *to speak, say.*
droit, *straight, right*; à droite, *to the right* (*hand*).
le droit, *the right.*
enverra, (he) *will send.*
facile, *easy.*
garder, *to keep.*
gauche, *left, clumsy*; à gauche, *to the left* (hand).
l'histoire, *the history, the story.*
jusqu'à, *as far as, up to.*
justifier, *to justify.*
lentement, *slowly.*
longtemps, *long* (of time).
le menuisier, *the carpenter.*
mesurer, *to measure.*
modifier, *to modify.*
montrer, *to show.*
paraître, *to appear, seem.*
penser, *to think.*
perdre, *to lose.*
peut-être, *perhaps.*
plaindre, *to pity.*
plaire, *to please.*
le poëme, *the poem.*
près de, *near.*
reconnaître, *to recognise.*
résolut, (he) *resolved.*
respirer, *to breathe.*
savoir, *to know.*
souvent, *often.*
le style, *the style.*
suivre, *to follow.*
toujours, *always.*
tourner, *to turn.*
le travail, *work.*
viendra, (he) *will come.*

Exercise 23

1. Il la reconnut aussitôt: c'était elle. 2. Il aperçut devant lui une femme qui marchait lentement. 3. J'ai suivi cette dame jusqu'à l'Arc de Triomphe. 4. Elle tourna à gauche pour entrer dans la rue de Rivoli. 5. Puis elle tourna à droite pour suivre la rue des Saints-Pères. 6. Il paraît qu'elle ne demeure pas tout près de chez moi. 7. Elle ne me plaît pas; montrez-m'en une autre. 8. Il la chercha à travers les rues. 9. Elle était bien cachée dans l'immense ville. 10. Il n'eut pas besoin de la chercher longtemps. 11. Il résolut d'écrire son poëme en beau style. 12. L'histoire fut un peu modifiée par le poëte. 13. Aussitôt que le poëme fut écrit, Jules le porta au journal. 14. Toutes les précautions sont bien prises. 15. Que direz-vous pour vous justifier?

Exercise 24

1. Do you not receive many letters? 2. We receive many. 3. Do you sell many goods? 4. We sell many. 5. Your brother likes beef and mutton. 6. Does that lady love her children? 7. Yes, sir, she is very fond of them. 8. Do you furnish goods to these merchants? 9. I furnish goods to these merchants, and they give me money. 10. Do your companions like fine clothes? 11. Our companions like fine clothes and good books. 12. Are you looking for my brother? 13. Yes, sir, I am looking for him, but I don't find him. 14. Does your brother waste his time? 15. He wastes his time and his money.

Key to Exercise 21

1. Jules arrived at the decision that the lady was a Parisian. 2. He used to discover a new beauty in the woman he loved. 3. New thoughts came into the poet's soul. 4. He opened the door. 5. He reddened a little, took her hand, and made her come in. 6. He retreated two steps to see her better. 7. I should have preferred her to be a hussy. 8. I very much fear that it is an old woman. 9. Hélène smiled and said no more. 10. He related the amours of Calypso and Dido to his mistress. 11. I did not look at her, sir. 12. They looked at her sideways in lowering their heads. 13. She crossed the Place de la Concorde. 14. She entered the rue de Rivoli. 15. He was obliged to descend into the road. 16. Does she live at Montmartre? 17. One would think that she felt Jules at her heels. 18. He dared not enter the shop. 19. He had a suspicion of a trap. 20. It was still winter. E. A. B.

GERMAN.—X

Interrogative Pronouns. — These are wer, *who*, was, *what*, and welcher, *which, what*. Wer and was are used as pronouns only. Welcher is mostly used as an interrog. adjective, but also quite frequently as a pron. Wer and was have no plur. forms. They are declined as follows:

Nom.	wer, *who.*	was, *what.*
Gen.	weſſen, *whose.*	weſſen, *of what.*
Dat.	wem, *to whom.*	
Acc.	wen, *whom.*	was, *what.*

The student will note that was has no dat. The dat. and acc. of was governed by prepositions is replaced by wo or wor prefixed to the prep., wor being used before a prep. beginning with a vowel. Thus, womit, *with what?* worin, *in what?*

Possessive Pronouns.—These are formed from the possessive adjective either by using the poss. adj. substantivally with the def. art. prefixed, or by prefixing the def. art. and adding the ending **ige** to the poss. adj. In either case the poss. adj. is declined like any other adj. used after a def. art. Thus, weſſen Buch iſt das? Es iſt das meine *or* das meinige. *Whose book is that? It is mine.*

The forms in ige are never used without the def. art. The following are the forms of the nom. sing. and plur. for all persons:

Sing.	*Plur.*
der, die, das meinige	die meinigen, *mine.*
der, die, das deinige	die deinigen, *thine.*
der, die, das ſeinige	die ſeinigen, *his.*
der, die, das ihrige	die ihrigen, *hers.*
der, die, das unſrige	die unſrigen, *ours.*
der, die, das eurige	die eurigen, *yours.*
der, die, das Ihrige	die Ihrigen, *yours.*
der, die, das ihrige	die ihrigen, *theirs.*

Indefinite Pronouns.—Man, *one*, is used as the indefinite subject of a verb. In the genitive ſein, ſeine, ſein are used, and in the dat. and acc. einem and einen respectively.

Jedermann, *everybody*, does not change in the oblique cases except that it takes the termination **s** in the gen.

Jemand, *someone*, and Niemand, *no one*, usually do not change in the oblique cases, except that they take **s** in the gen., but in the dat. and acc. they can take the terminations **em, en** respectively if the sentence would otherwise be ambiguous.

Etwas, *something*, and nichts, *nothing*, are always invariable in form. When they are followed by an adj. this adj. is treated as if it were a noun in apposition. Thus, ich möchte etwas ſchönes haben, *I should like to have something beautiful.*

Einander is only used in the dat. or acc. and is invariable in form. Thus, ſie wiſſen nichts von einander, *they know nothing of one another.*

Prepositions.—These are best classified according to the cases they govern.

Class 1, prepositions that govern the gen. case.
Class 2, prepositions that govern the dat. case.
Class 3, prepositions that govern the acc. case.
Class 4, prepositions that govern either the dat. or acc case.

The commonest of these are:

(1) *Genitive*	(2) *Dative*
(an)ſtatt, *instead of.*	aus, *out of.*
trotz, *in spite of.*	außer, *except.*
um.....willen, *for the sake of.*	bei, *near, by.*
unweit, *not far from.*	binnen, *within.*
während, *during.*	mit, *with.*
wegen, *on account of.*	nach, *after, to.*
	nebſt, *along with, together with.*
	ſammt, *together with.*
	ſeit, *since.*
	von, *from, of.*
	zu, *to, at.*

(3) *Accusative*	(4) *Dative or Accusative*
durch, *through.*	an, *on.*
für, *for.*	auf, *on, on to.*
gegen, *against.*	hinter, *behind.*
ohne, *without.*	in, *in, into.*
um, *round, about, at* (of time).	neben, *beside.*
wider, *against.*	über, *over, about.*
	unter, *under, among.*
	vor, *before.*
	zwiſchen, *between.*

All the prepositions belonging to Class 4 govern the dat. when indicating rest at a place; they govern the acc. when indicating motion towards a place.

Adverbs.—We have stated that practically all adjectives can be used as adverbs in their uninflected form. This is true not only for the positive but also for the comparative and superlative degrees, though the latter is not often used adverbially.

Thus we say, er ſpielt gut, *he plays well;* dieſes Lied klingt beſſer *this song sounds better;* and er trägt den beſt ſitzenden Rock, *he wears the best-fitting coat.*

Conjunctions.—The co-ordinative conjunctions, i.e. those which join clauses of the same rank, cause a little difficulty because some of them necessitate an inversion of the usual order—that is, the subject of the sentence they introduce is placed after the verb. These are originally adverbs. The more ordinary, simply connective conjunctions which do not require the inverted order are the following: und, *and*, aber, allein, *but*, ſondern, *but* (after negative

clauses only), denn, *for*, entweder, *either*, and oder, *or*. All these stand at the beginning of the clause except aber, which may be placed in a variety of positions. It may often be translated by *however*.

Declension of Proper Names.—Names of persons, places, and the neuter names of countries take in the gen. the strong termination **s**. Thus Karls, Englands.

Names of females ending in **e**, and names of males ending in a sibilant, take in the gen. **ens** and in the dat. **en**. Thus, Sophiens, Sophien.

Declension of Foreign Nouns.—Many nouns of foreign origin have become completely naturalised, and these are declined like other German nouns.

All masculines in unaccented **or**, such as Dok'tor, have a strong sing. and a weak plur. Further, in the plur. the accent is shifted to the **or**. Thus, der Dok'tor, gen. des Dok'tors, all cases in the plur. Doktor'en.

Most mas. nouns in **al, an, ar, ast** are declined like strong nouns of Class 2. Thus, Major', gen. Majors', plur. Major'e (dat. plur. Major'en). Note that in this word the accent is on **or** in the sing. A few modify in the plur., e.g. Kanal', *canal*, Kaplan', *chaplain*, Palast', *palace*. Most other mas. nouns are declined according to the weak declension.

Practically all fem. nouns are declined according to the weak declension.

Nearly all neut. nouns follow the strong declension, Class 2. Thus, Programm' gen. Programms', nom. plur. Program'me. Two, however, are declined according to Class 3: Regiment', nom. plur. Regimen'ter, and Spital', *hospital*, Spitäler.

Some nouns in um take **s** in gen. sing. and **en** in the plur. Thus, Museum, plur. Museen. A few nouns in **al** and **il** take **s**, in gen. sing. and **ien**, in the plur. Thus Fossil, plur. Fossilien.

Many nouns of Latin and Greek origin retain their original plur. forms though they take the German **s** in the gen. sing. Thus, Exa'men, *examination*, plur. Exa'mina.

French, English, and Italian nouns retain their original plurals. Thus, Details', Lords.

In two words the Low German plur. is colloquially used: Kerls, *fellows;* Jungens, *boys*.

Most of the above, however, have regular German plur. forms as well.

Gender of Nouns.—The following are a few general rules for the gender of nouns, but there are, however, many exceptions.

MASCULINES.—Most men and male animals. Names of months, days, seasons, and stones. Words ending in **ig, ich, ing, ling**.

FEMININES.—Most women and female animals. Words ending in **ei, heit, keit, schaft, kunft, ung, in, acht, uld.**
Foreign words ending in **ion, ie, ik, tät.**

NEUTERS.—All words that are not really nouns but are used as such, e.g. the infinitives of verbs, the letters of the alphabet. Most names of countries and places. Most names of metals. Most words ending in **tum** and **nis**. Collective Nouns with the prefix **ge**. Diminutives in **chen** and **lein**.

Reflexive Verbs.—We will now give a simple tense of such a verb in full and the first pers. sing. of one or two compound tenses. The reflexive pronoun is placed after the finite verb of which it is either the direct or the indirect object; but in the compound tenses the participle or infinitive is, as always, placed at the end, i.e. it follows the reflexive pronoun.

sich freuen, *to be pleased.*

Pres. Ind.	*Fut. Ind.*
ich freue mich	ich werde mich freuen
du freuest dich	*Perf. Ind.*
er freut sich	
wir freuen uns	ich habe mich gefreut
ihr freuet euch	*Fut. Perf. Ind.*
Sie freuen sich	
sie freuen sich	ich werde mich gefreut haben

Prefixes.—In the Infin. and Participles the prefix always comes before the verb and they are written together in one word. In all the other simple forms the separable prefix comes after the verb and they are written separately.

an'fangen, *to begin*, 2c

Pres. Inf. an'fangen *Pres. Part.* an'fangend
Past Part. an'gefangen.

Pres. Ind.	*Fut. Ind.*	*Pret. Ind.*
ich fange an	ich werde an'fangen	ich fing an
du fängst an	*Perf. Ind.*	
er fängt an		
wir fangen an	ich habe an'gefangen	
ihr fangt an	*Fut. Perf. Ind.*	
Sie fangen an		
sie fangen an	ich werde an'gefangen haben	

The student will note that in the Past Part. the prefix **ge** is inserted between the separable prefix **an** and the stem of the Past Part. Similarly, when the Infin. with zu is used the **zu** is placed between the prefix an and the Infin. Thus, anzufangen—all written in one word.

In a principal clause in which the order is not inverted the prefix is placed not only after the verb, but normally right at the

end of the clause. Thus, er fing in dieſem Jahr zu lernen an, *he began to learn this year.*

In a clause in inverted order the prefix naturally goes to the end. Thus, nachher fing er wunder'ſchön zu ſingen an, *afterwards he began to sing beautifully.*

In dependent clauses, where the finite verb goes to the end, it must obviously come after the prefix, and in that case the two are written together in one word. Thus, Sie hörte auf als er zu ſingen anfing, *she left off when he began to sing.* (aufhören, *to leave off*, is also a verb with a separable prefix).

VOCABULARY

Fortſetzung, w.f., *continuation.*
ſogleich, *immediately.*
bekommen, (*see* kommen), *to get.*
ernſthaft, *earnest.*
Schlafzimmer, s.n.1, *bedroom.*
zubringen, w., *to spend* (of time).
weiterreiſen, w., *to travel further.*
Stadt, s.f.2, *town.*
Urlaub, s.m., *holiday, leave.*
verſchieden, *various.*
Bilderausſtellung, w.f., *picture exhibition.*
außerordentlich, *extraordinary.*
beiwohnen, w., gov. dat., *to be present at.*
Opernhaus, s.n.2, *opera house.*
Fremde, w.m., *stranger, foreigner.*
Nachtleben, s.n.1, *life at night.*
Bierhaus, s.n.3, *beer house.*
mitten in, *in the middle of.*
eben, *quite, just.*
wie, *as.*
zwiſchen, *between.*
empfehlen, s.1c, *to recommend.*
behaglich, *comfortable.*
Bett, n., *bed.*
bald, *soon.*
um, *in order to.*
ehe, *before.*
zu Ende gehen, *to come to an end.*
unweſentlich, *unnecessary.*
Muſeum, *museum.*
wunderſchön, *very beautiful.*
Konzert, s.n.2, *concert.*
ſich amuſieren, *to enjoy oneself.*
prachtvoll, *splendid.*
königlich, *royal.*
als, *as.*
auffallen, s.2c, gov. dat., *to strike.*
Bier, s.n.2, *beer.*
voll, *full.*
faſt, *almost.*
belebt, *lively.*
gefallen, s.2c, impers. verb, gov. dat., *to please.*

Exercise 27

Eine Reiſe nach Deutſchland (Fortſetzung).

Ich kam zwiſchen 5 und 6 Uhr in Berlin an[1], und fuhr ſogleich nach einem kleinen Hotel welches mir empfohlen worden war. Ich bekam dort ein behagliches Schlafzimmer mit einem guten Bett. Ich brachte nur wenige Tage in Berlin zu[2], denn ich mußte bald weiterreiſen um andere deutſche Städte zu beſuchen, ehe mein kurzer Urlaub zu Ende ging. Ich beſuchte verſchiedene Muſeen und Bilderausſtellungen[3], hörte zwei wunderſchöne Konzerte, ging drei[4] viermal ins Theater, wo ich mich außerordentlich gut amuſierte, und wohnte einer prachtvollen Vorſtellung im königlichen Opernhaus[5] bei. Was mir als Fremden aber am meiſten auffiel[6], das war das Nachtleben Berlins; bis drei oder vier Uhr Morgens ſind die Cafés[7] und Bierhäuſer voll von Menſchen, und die Straßen mitten in der Stadt ſind faſt eben ſo belebt wie am Tage. Andere Städte in Deutſchland gefielen mir aber viel beſſer als Berlin, manche weil ſie ſchöner und manche weil ſie älter ſind[8].

NOTES:

(1) **an**—as explained above, the separable prefix is placed right at the end of the clause. (2) **zu**, *see* (1). (3) **Bilderausſtellungen**—compound noun **bilder** is gen. plur. (4) **drei**, for **dreimal**—it is unnecessary to repeat the second component **mal**: it is understood with the first numeral. (5) **Opernhaus**—compound noun, **Opern** is gen. plur. (6) **auffiel**—dependent clause, and therefore, as explained above, the prefix and verb are written as one word at the end. (7) **Cafés**, foreign noun which retains its foreign plural. (8) **ſind**—this is understood after **ſchöner**, and need not be used twice.

Exercise 28

1. They arrived in London at 3 o'clock on Tuesday, June 9th, 1899. 2. I often travel to London, but they had not been there since ten years. 3. The many new hotels and cafés struck them most; they enjoyed themselves very much during the month that they spent in London. 4. The theatres and concerts pleased them exceedingly, but they would not like to live in a large town, for they love the quiet life in a small town. 5. The streets in London are so very lively and there is so much noise. 6. However, they said that their bedrooms in the hotel were quiet and the beds good, so they slept well, and on the whole they enjoyed themselves.

Key to Exercise 25

I travelled (have made a journey) to Germany last autumn. I drove with my luggage in a motor-car to the station, bought a first-class ticket there, and had my trunks registered to the Friedrichstrasze (station). I had to (must) pay 10 marks overweight. At last the registering was done (accomplished) and I got into the train which was waiting at the station. The train was only a little late (had only a little delay), consequently I arrived pretty punctually in Folkestone, where I went on board; after I had taken a cup of tea and some Dutch rusks, I lay down to sleep in the cabin that had been assigned to me. In the morning early, at 4 o'clock, we arrived in Flushing: the Custom House officers let me through without examining my small luggage, and I got into the Berlin train. This was a so-called D train, an express train with a restaurant car where I had (let give to me) coffee and rolls for my (the) first breakfast, and where later I also ate my lunch (second breakfast) and dinner. The train journey was rather boring, for the country in Holland and the North German plain through which we passed is, on the whole, flat and uninteresting. At the German frontier I had to get out for the Customs examination, for not only the small luggage but also the big trunks were examined there (for one examined, etc.).

Key to Exercise 26

1. Er iſt dreimal in Deutſchland geweſen; einmal ging er mit ſeinem Vater und zweimal mit ſeiner Schweſter. 2. Viele Tauſende von Menſchen reiſen nach Deutſchland; viele von ihnen gehen von Folkeſtone nach Vließingen und von dort nach den großen Städten in der norddeutſchen Ebene. 3. Er liebt nicht das Eiſenbahnfahren, ſondern iſt viel glücklicher an Bord eines Schiffes. 4. Als er an dem Bahnhof ankam ließ er ihr Gepäck nach Berlin einſchreiben. 5. Berliner Kaffee und Brödchen, die man zum Frühſtück hat, ſind ſehr gut. 6. Ich ging vergangenes Jahr zum erſten Mal nach Deutſchland. 7. Die Zollbeamten laſſen einen nicht durch ohne die Koffer und das Handgepäck zu unterſuchen.

M. A. L.

RUSSIAN.—III

The Noun

7. The genitive endings in singular are :

Masculine : **а, я, я,** instead of the nominative endings **ъ, й, ь**, respectively.

Feminine : **ы, и, и,** instead of the nominative endings **а, я, ь,** respectively.

Neuter : **а, я,** instead of the nominative endings **о, е,** respectively. (*See* Rule 1.)

Examples : Фабрика́нта, това́ра, казначе́я, сара́я, покупа́теля, ве́кселя, фи́рмы, торго́вли, при́были, сло́ва, по́ля.

8. The genitive generally denotes possession, derivation, or quantity.

Examples

Това́ръ фабрика́нта (ta-wár fa-bri-kán-ta), *the manufacturer's goods.*

Письмо́ покупа́теля (pis'-mó pa-ku-pá-te-lya), *the customer's letter.*

Прика́зъ хозя́ина (pri-kás kho-zyá-i-na), *the master's order.*

Фо́рма ве́кселя (fór-ma vék-se-lya), *the form of a bill.*

Длина́ сара́я (dli-ná sa-rá-ya), *the length of the stable.*

Кусо́къ хлѣба (ku-sók kulyé-ba), *a piece of bread.*

Репута́ція фи́рмы (re-pu-tá-tsi-ya fir'-mwü), *the reputation of the firm.*

Обы́чай торго́вли (a-bwü-chai tar-góv-li), *a custom of commerce.*

9. The genitive is used instead of the accusative in negative sentences where the verb is accompanied by the word не (nye) = not.

Examples

Я не покупа́ю това́ра (ya nye pa-ku-pá-yu ta-vá-ra), *I do not buy any goods.*

Мы не зна́емъ фи́рмы Б. (mwü nye zná-yem fír-mwü B.), *we do not know the firm B.*

Хозя́инъ не подпи́сываетъ письма́ (kho-zyá-in nye pat-pi-swü-va-yet pis'-má), *the master does not sign the letter.*

10. The genitive is governed by a large number of words from the various parts of speech of which for the present only a few are given below :

(*a*) Nouns—all such denoting quantities.

Examples

арши́нъ сукна́	(ar-shín suk-ná),	*an arshin of cloth.*
галло́нъ вина́	(gal-lón vi-ná),	*a gallon of wine.*
фунтъ ше́рсти	(funt shér-sti),	*a pound of wool.*
куби́ческій футъ воды́	(ku-bí-ches-kiĭ fut va-dwü'),	*a cubic foot of water.*
акръ земли́	(akr zyem-lí),	*an acre land.*

(*b*) The special numbers :

два, m. and n.	(dva),	*two*
двѣ, f.	(dvye),	*two*
три	(tree),	*three*
четы́ре	(che-tü-re),	*four.*

N.B.—All the above numbers require after them the genitive singular.

(*c*) Adverbs of Quantity :

Ско́лько	(skól'-ko),	*how much, how many.*
Сто́лько	(stól'-ko),	*so much,* or *as much, as many* or *so many.*
Мно́го	(mnó-go),	*much, many.*
Ма́ло	(má-lo),	*a few, a little.*
Немно́го	(nye-mnó-go),	*not much, a little.*
Нѣсколько	(nyé-skol'-ko),	*some.*
Дово́льно	(da-vól'-no),	*sufficient, enough.*
Доста́точно	(da-stá-toch-no),	*sufficient.*
Недоста́точно	(nye-da stá-toch-no),	*insufficient.*

(*d*) The verbs :

Ожида́ть	(a-zhi-dát'),	*to expect.*
Избѣга́ть	(iz-bye-gát'),	*to evade.*
Лиша́ть	(li-shát'),	*to deprive.*

(*e*) Odd phrases like :

жаль	(zhal'),	*it is a pity for the . . .*
жа́лко	(zhál-ko),	*it is a pity for the . . .*

(*f*) All comparative adjectives and adverbs.

Examples

бѣднѣе	(byed-nye-ye),	*poorer* (than).
бога́че	(ba-gá-che),	*richer* (than).
доро́же	(da-ró-zhe),	*dearer* (than).
ти́ше	(tí-she),	*quieter* (than).
ху́же	(khú-zhe),	*worse* (than).

(*g*) The prepositions :

	(1) безъ	(bez),	*without.*
	(2) для	(dlya),	*for.*
	(3) до	(do),	*up to, before.*
	(4) изъ	(eez),	*out of, from.*
	(5) отъ, съ	(ot, ss),	*from, of.*
	(6) ра́ди	(rádyi),	*for the sake of.*
	(7) у	(u),	*at.*
also :	о́коло	(óh-ko-lo),	*about, round.*
	по́слѣ	(pós-lye),	*after.*

Practice VII

Correct, changing into accusatives or genitives, as the case may be, the nominatives in the following sentences :

1. Я выполня́ю зака́зъ покупа́тель (ya vwü-pol-nyá-yu za-káz pa-ku-pá-tel'), *I execute the order of the customer.*

2. Мы соблюда́емъ интере́съ фи́рма (mwü sa-blyu-dá-yem in-tye-rés fír-ma), *We obscrve* (look after) *the interest of the firm.*

3. Онъ не понима́етъ сло́во по-англійски (on nye pa-ni-má-yet sló-vo pa-an-glí-ski), *he does not understand a word of English.*

4. Вы не конча́ете разгово́ръ (vwü nye kan chá-ye-tye ras-ga-vór), *you do not finish the conversation.*

5. Жела́ю получи́ть то́нна шерсть (zhe-lá-yu pa-lu-chít' tón-na sherst'), *I wish to receive* (get) *a ton of wool.*

Practice VIII

Turn into nominatives the following genitives, after omitting the first of each couple of words :

Изъ Россіи	(iz ras-sí-i),	*from Russia.*
До Парижа	(da pa-ri-zha),	*up to Paris.*
у Ротшильда	(u rót-shil'-da),	*at Rothschild's.*
Около Лондона	(ó-ko-lo lón-do-na),	*round London.*
Послѣ урожая	(pós-lye u-ra-zhá-ya),	*after the harvest.*
Съ горя	(s gó-rya),	*from trouble.*
Отъ боли	(at bó-lyi),	*from pain.*
Безъ ссуды	(bez ssú-dü),	*without a loan.*
Жалко работы	(zhall-ko ra-bó-tü),	*it's a pity for the work.*

The Verb

11. The verb **дава́ть** da-vát', *to give*, and all the other verbs which contain this word in their final formation are conjugated as follows :

Sing.

Я даю́	Ты даёшь	Онъ, она́, оно́ даётъ
I give	*thou givest*	*he, she, it gives.*

Plur.

Мы даёмъ	Вы даёте	Они́, онѣ, они́ даю́тъ
We give	*you give*	*they* (m.), *they* (f.), *they* (n.), *give.*

Practice IX

Conjugate the following :

Продава́ть	(pra-da-vát'),	*to sell.*
Отдава́ть	(at-da-vát'),	*to give away, to give back.*
Придава́ть	(pri-da-vát'),	*to add to....*
Передава́ть	(pe-re-da-vát'),	*to convey, hand over.*
Выдава́ть	(vwü-da-vát'),	*to hand out, deliver out.*
Издава́ть	(iz-da-vát'),	*to emit, issue, publish.*

12. The verbs ending in the Infinitive with **ова́ть**, such as чу́вствовать (chúfstva-vat'), *to feel*, lose in the conjugation of the present tense the part ова by changing it into у and following Rule 6, as exemplified below :

Sing.

Я чу́вствую	Ты чу́вствуешь	Онъ, она́, оно́ чу́вствуетъ
(ya chúf-svu-yu), *I feel.*	(tü chúf-stvu-yesh), *thou feelest.*	(on, aná, anó chúf-stvu-yet), *he, she, it feels.*

Plur.

Мы чу́вствуемъ	Вы чу́вствуете	Они, онѣ, они́ чу́вствуютъ
(mwü chúf-stvu-yem), *We feel.*	(vwü chúf-stvu-ye-tye), *you feel.*	(aní, anyé, aní chúf-stvu-yut), *they* (m.), *they* (f.), *they* (n.), *feel.*

Practice X

Conjugate the following :

Торгова́ть	(tar-ga-vát'),	*to deal in, to sell, to bargain for.*
Путеше́ствовать	(pu-tye-shé-stvo-vat'),	*to travel.*
Тре́бовать	(tryé-bo-vat'),	*to demand, claim, require, exact.*
Про́бовать	(pró-bo-vat'),	*to test.*
Корреспонди́ровать	(kar-res-pan-di-ro-vat'),	*to correspond.*
Телегрази́ровать	(tye-lye-gra-fi-ro-vat'),	*to wire, cable, telegraph.*
Импорти́ровать	(im-par-ti-ro-vat'),	*to import.*
Экспорти́ровать	(ex-par-tí-ro-vat'),	*to export.*

13. By adding the suffix **ся** to any verb, in any mood, except in the passive voice, a reflective verb is formed. Thus рекомендова́ться means *to recommend oneself.* The particle ся becomes in first singular and in the second plural **сь**, but in all the other persons o the present tense it remains unchanged.

Examples

Я рекомендую́сь	(ya rye-ka-men-dú-yus'),	*I am introducing myself.*
Ты счита́ешься	(tü s-chi-tá yesh-sya),	*you are taken for* (2nd sing.).
Разумѣется	(ra-zu-myé-yet-sya),	*it is understood.*
Мы занима́емся	(mwü za-ni-má-yem-sya),	*we occupy ourselves.*
Вы стара́етесь	(vwü sta-rá-ye-tyes'),	*you are trying, endeavouring.*
Они́ ошиба́ются	(ani a-shi-bá-yut-sya),	*they are making a mistake.*

Practice XI

Conjugate the following reflective verbs :

Называ́ться	(na-zü-vát'-sya),	*to be called, named.*
Счита́ться	(s-chi-tát'-sya),	*to be reckoned as, to be taken for.*
Стара́ться	(sta-rát'-sya),	*to make an effort, to endeavour*
Отлича́ться	(at-li-chát'-sya),	*to excel, to be distinguished by....*
Ошиба́ться	(a-shi-bát'-sya),	*to make a mistake, to err.*
Стѣня́ться	(s-tyes'-nyát'-sya),	*to constrain oneself, lack in courage.*

14. By placing the particle **ли** after a verb the sentence assumes an interrogative meaning.

Examples

Зна́ете ли Вы ?	(zná-ye-tye-li vwü),	*do you know ?*
Рабо́таютъ ли они́ ?	(ra-bó-ta-yut li ani),	*do they work ?*

VOCABULARY

Сего́дня	(sye-vó-dnya),	*to-day.*
встрѣча́ть	(vstrye-chat'),	*to meet.*
покупа́тель	(pa-ku-pá-tyel'),	*the client.*
Нашъ	(nash),	*our.*

а́гентъ	(á-gent), *	*the agent.*
хорошо́	(kha-ra-shó),	*good, well.*
знать	(znat'),	*to know.*
Россія	(ra-ssí-ya),	*Russia.*
Занима́ть	(za-ni-mát'),	*to occupy.*
весь	(ves'),	*the whole of, the entire, all the.*
ве́рхній	(vér-khnyi),	*upper.*
этаж́ъ	(ae-tázh),	*storey.*
Жела́ть	(zhe-lát'),	*to wish.*
цѣна́	(tse-ná),	*the price.*
отвѣча́ть	(at-vye-chát'),	*to answer.*
по ру́сски	(pa-rús-ki),	*in Russian.*
что	(shto),	*what.*
тепе́рь	(tye-pér'),	*now.*
покупа́ть	(pa-ku-pat'),	*to buy.*
Ру́сскій	(rús-ki),	*the Russian.*
гость	(gost'),	*the guest.*
прекра́сно	(pre-krás-no),	*nicely, excellently.*
понима́ть	(pa-ni-mát'),	*to understand.*
по англі́йски	(pa-an-glí-ski),	*English.*
Вашъ	(vash),	*your.*
представи́тель	(pret-sta-ví-tyel'),	*representative.*
посѣща́ть	(pa-sye-shchát'),	*to visit.*
насъ	(nass),	*us.*
ка́ждый	(kázh-dwü),	*each, every.*
годъ	(got),	*year.*
Ихъ	(ikh), †	*their.*
зака́зъ	(za-kás),	*order.*
поглоща́ть	(pa-gla-shchát'),	*to absorb.*
всѣ n.	(vsyo),	*all the, the whole.*
на́ше n.	(ná-she),	*our.*
вре́мя	(vré-mya),	*time.*
Его́	(ye-vó),	*his.*
расхо́дъ	(ras-khót),	*expenditure.*
превыша́ть	(pre-vwü-shát),	*to exceed.*
дохо́дъ	(da-khót),	*income.*
Корреспонде́нтъ	(kar-res-pan-dént),	*correspondent.*
предлага́ть	(pred-la-gat'),	*to offer.*
намъ, dat.	(nam),	*us.*
свой	(sva-yi),	*his.*
услу́ги	(u-slú-gi),	*services.*
Васъ, accus.	(vass),	*you.*
уважа́ть	(u-va-zhat'),	*esteem, respect.*
потому́ что	(pa-ta-m'u shto),	*because.*
постоя́нно	(pa-sta-yán-no),	*continually.*
рабо́тать	(ra-bó-tat'),	*to work.*
лѣнтя́й	(lyen-tyáĭ),	*idler.*
почему́	(pa-che-mú),	*why.*
не	(nye),	*not.*
тамъ	(tam),	*there.*
де́ньги	(dén'-gi), *	*money.*
жаль	(zhal'),	*what a pity, it's a pity.*
такъ	(tak),	*so.*
мно́го	(mnó-go),	*much.*
гуля́ть	(gu-lyát'),	*to go about idle.*
провѣря́ть	(pra-vye-ryát'),	*to check, verify.*
счётъ	(s-chot),	*invoice, account.*
когда́	(ka-gdá),	*when.*
отправля́ть	(at-prav-lyát'),	*to send off, ship, forward.*
това́ръ	(ta-vár),	*the goods.*
фабрика́нтъ	(fa-bri-kánt)	*the manufacturer.*
дѣлать	(dyé-lat'),	*to make, do.*
предложе́ніе	(pred-lo-zhé-ni-ye),	*an offer.*
повторя́ть	(paf-ta-ryát'),	*to repeat.*
сочиня́ть	(sa-chi-nyát'),	*to compose.*
письмо́	(pis'-mó),	*a letter* (correspondence).

* *g* always hard.

† *kh*—as Scotch *ch* in *loch.*

ста́ршій прика́щикъ	(stár-shyi pri-ká-shchik),	*head warehouseman.*
выполня́ть	(vwü-pol-nyát'),	*to execute, effect.*
о́чень	(ó-chen'),	*very.*
На́шу, f. accus.	(ná-shu),	*our.*
Фи́рма	(fír-ma),	*firm.*
принима́ть	(pri-ni-mát'),	*to accept.*
Ва́ше, n.	(vá-she),	*your.*
По́шлина	(pó-shli-na),	*the duty* (customs).
счита́ть	(s-chi-tat'),	*to charge, reckon.*
за	(za),	*for.*
свой	(svoĭ),	*his* (own).
до́рого	(dó-ro-go),	*dear.*
дёшево	(dyó-sho-vo),	*cheap.*
дѣло	(dyé-lo),	*business, trade, line, speciality.*
большо́й	(bal'-shóĭ),	*big.*
оборо́тъ	(a-ba-rót),	*turnover.*
приготовля́ть	(pri-ga-tav-lyát'),	*to prepare.*
для Васъ	(dlya vas),	*for you.*
кру́пный	(krúp-nü),	*very big, huge.*
Вамъ	(vam),	*you, to you.*
сей	(syeĭ),	*this.*
мы	(mwü),	*we.*
увѣре́нъ	(u-vye-re-nü),	*are sure, positive.*
предпочита́ть	(pret-pa-chi-tát'),	*to prefer.*
како́й	(ka-kóĭ),	*which, what.*
получа́ть	(pa-lu-chát'),	*to receive.*

Exercise 3

Translate the following into English:

1. Мы сего́дня встрѣча́емъ покупа́теля.
2. Нашъ а́гентъ хорошо́ зна́етъ Россію.
3. Мы занима́емъ всѣ́ пе́рвый эта́жъ.
4. Покупа́тель жела́етъ знать цѣ́ну това́ра.
5. Что вы тепе́рь покупа́ете?
6. Нашъ ру́сскій гость прекра́сно понима́етъ по англі́йски.
7. Мы отвѣча́емъ по ру́сски.
8. Вашъ представи́тель насъ посѣща́етъ ка́ждый годъ.

Exercise 4

Translate the following into Russian:

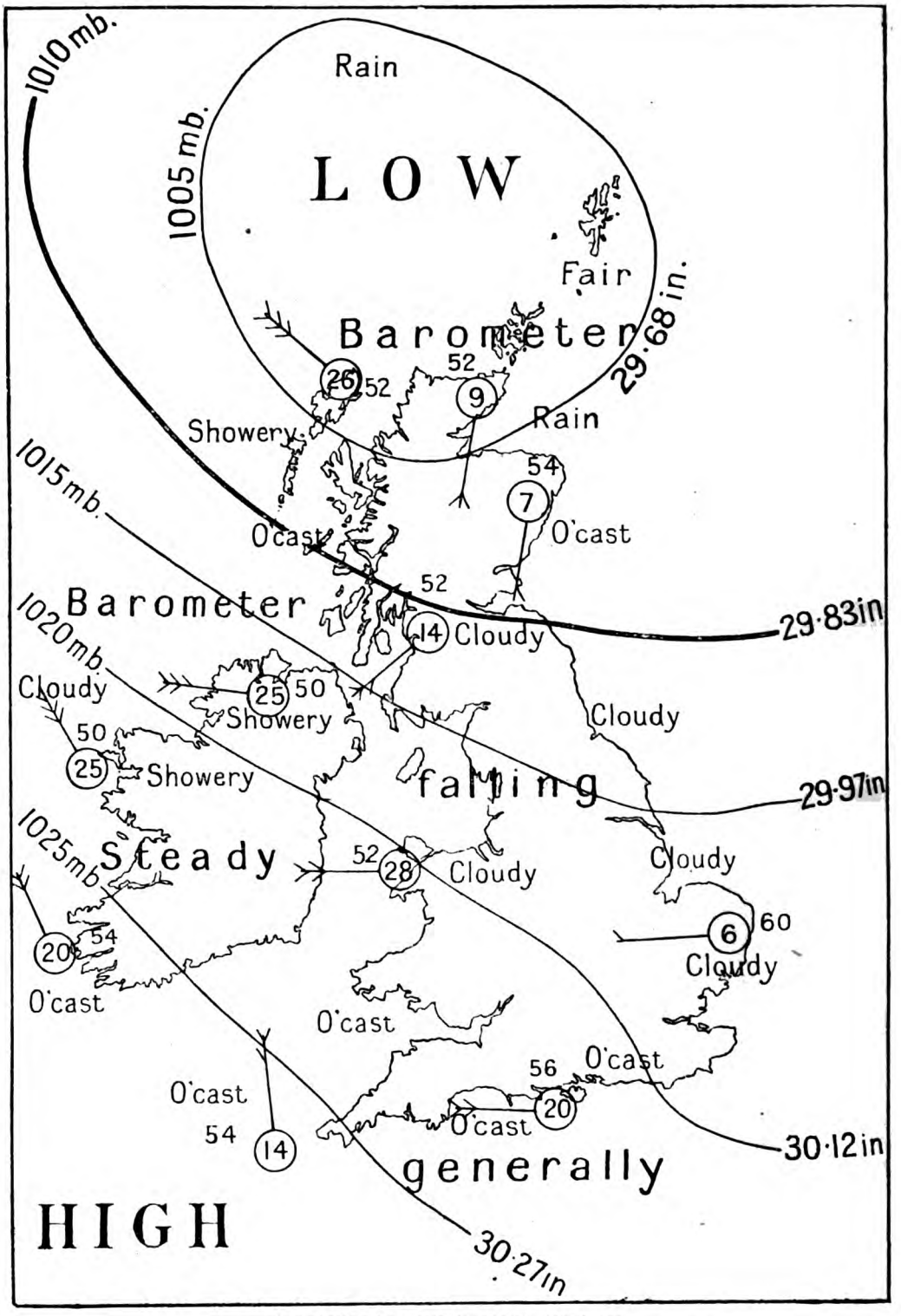
1. I am not sending the goods to-day.
2. Our head warehouseman executes now your whole order.
3. The client greatly respects our firm.
4. We accept your offer.
5. The duty exceeds the price of the goods.
6. You buy the goods very cheap.

Conversations

РАЗГОВО́РЫ (ras-ga-vó-rwü).

Здра́вствуйте [be saluted]	(zdráf-stvuĭ-tye),	*good morning. good day, good evening.*
До́брое у́тро	(dob-ró-ye ú-tro),	*good morning.*
До́брый ве́черъ	(dób-rüĭ wyé-cher),	*good evening.*
До́бро пожа́ловать	(dób-ro pa-zhá-lo-vat'),	*you are welcome.*
Сади́тесь, пожа́луйста	(sa-dí-tyes' pa-zhá-luĭ-sta),	*take a seat please.*
Радъ Васъ ви́дѣть	(rad vass ví-dyet'),	*glad to see you.*
Ну, какъ пожива́ете?	(nu, kak pa-hi-vá-ye-tye),	*well, how are you going on?*
Покорне́йше бла-годарю́.	(pa-kór-nyei-she bla-ga-da-ryú),	*much obliged.*
Какъ дѣла́	(kak dye-lá),	*how is business?*
Спаси́бо, всѣ́ въ поря́дкѣ.	(spa-sí-bo fsyo f-pa-ryát-kye),	*thanks, things are all right.*

A. C.



A TYPICAL WEATHER CHART,

such as is issued by the Meteorological Office. The isobars (shown both in inches and millibars) enable one to study the distribution of atmospheric pressure over large areas and so to forecast the weather with reasonable accuracy. The arrows indicate the direction of the ground wind, the figures in the circles indicating its velocity in miles per hour; the number of the feathers varies according to the force of the wind. Figures not in circles show temperature at sea level in degrees Fahrenheit.

Continued from page 229.

GEOGRAPHY:

Contributors:—Robert Finch, F.R.G.S.; W. H. Koebel; Sir John Scott-Keltie, LL.D.; Cyril J. Silverston, B.Sc.(Lond.).

WEATHER AND WEATHER RECORDS

WITH the establishment of a large number of observing stations situated in the various civilised centres of the world, and, in recent years, with the advance of wireless telegraphy, which has enabled meteorological observations to be transmitted from vessels in the middle of the oceans, it has been possible to forecast the weather with a very reasonable degree of accuracy. The Great War gave a great impetus to the science of meteorology. Gunners and airmen were largely dependent on accurate weather reports; and the development of aircraft and wireless made such reports possible, since conditions obtaining in high altitudes could be, and were, made accurately known. The system of air reports that came into being during the war has been adapted to peace conditions.

Weather Forecasts

In Great Britain daily charts are issued by the Meteorological Office, and are accompanied by a report giving particulars of the pressures, temperatures, rainfall, sunshine, etc., at the different stations with which there is communication.

In preparing these weather charts the barometric pressures, as telegraphed to London every morning, are marked on a map, and lines are drawn joining those places where the pressure is the same. These lines are called isobars, and are of great value in enabling us to study the distribution of atmospheric pressure over large areas, and thus to prophesy the probable weather over the whole area covered.

In discussing the permanent winds we noticed that the air always moves from a place where pressure is higher to a place where pressure is lower. Now if we study the actual direction of the wind in conjunction with a map on which the isobars have been traced, we find that though it tends to cross from higher to lower isobars actually it is roughly parallel with them. It is also found that frequently the isobars take the form of closed curves, the area of lowest pressure being within a kind of circle. Such a distribution of pressure in the atmosphere is known as a Cyclone. In the Northern hemisphere the direction of the wind in a cyclone is always anti-clockwise. In the Southern hemisphere, on the other hand, this is the reverse, the cyclonic winds being clockwise in direction.

In the centre of the low pressure area there is an upward current of air with, of course, a tendency for air from the surrounding regions to flow in to take its place. The ascending air expands as the pressure gets less, and this expansion being accompanied by cooling, causes a precipitation of rain.

If the barometric map discloses a distribution of the isobars so that the *highest* pressure is within the circle the condition is known as an *Anti-cyclone*. The air in the centre is calm, warm in summer and cold in winter, while around it the winds blow spirally in a clockwise direction in the Northern hemisphere and in the reverse direction in the Southern hemisphere. Anti-cyclonic weather is generally fine.

Cyclonic Areas

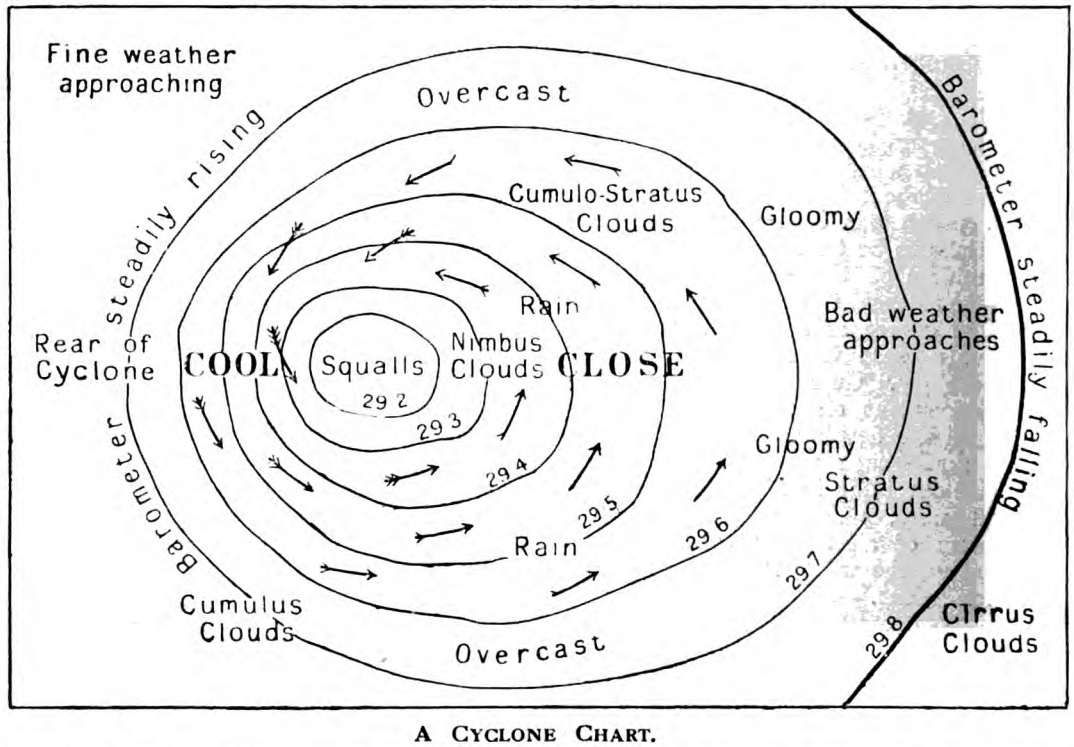
Cyclones move as a whole across the face of the globe at varying rates, the mean being about 20 miles an hour. On the Equator their direction is from east to west, but in higher latitudes they move from west to east. A cyclonic area may be as much as 1,000 miles across. As a cyclone moves across any place the weather changes, generally speaking, in a fairly regular way. An inspection of the annexed diagram will show pretty clearly the succession of weather that may be expected. Anti-cyclones when formed are much more permanent than cyclones, and may remain for many days, giving settled weather over large areas.

When we speak of the climate of a region

or country we mean by this the average condition of the weather which obtains over the district. From considerations which we have discussed above, these depend, as we have seen, upon the temperature, the moisture (both in the atmosphere and precipitated), and also upon the winds. But as these two latter factors are mainly influenced by the former, the climates of the world have been grouped in what we may call temperature zones, and these do in fact

whole the best method was that proposed by Supan.

Supan's suggestion was to divide the globe into zones of temperature bounded by isotherms. In this classification there is a Hot Belt bounded on each side by the mean annual isotherm of 68° Fahr. This is practically coincident with the trade-wind limits, and also with the limit beyond which palms do not grow. North and south of the Hot Belt are the two temperate zones, which



A CYCLONE CHART.

Though the wind tends to cross from higher to lower isobars, it remains roughly parallel with them. The isobars normally take the form of closed curves, the area of lowest pressures being within a kind of circle. In the Northern hemisphere the direction of a cyclone is always anti-clockwise, and in the Southern hemisphere always clockwise.

largely represent real and abiding differences of climate.

We have already alluded to the method of dividing the globe into five zones, namely, the Torrid, two Temperate, and two Frigid; but this method on careful comparison is found to be inadequate, as it groups together countries with very different climates, such as, for the sake of example, the Mediterranean countries and Canada. No account can be taken in this rough method of classification of prevailing winds, ocean currents, etc., which, as we have seen, largely modify climatic conditions. Some other method of grouping was therefore desirable, and on the

extend towards the Poles as far as the isotherm of 50° Fahr. for the warmest month. This is taken because it is more important that it should be hot in summer than that it is cold in winter, as if the temperature does not rise as high as 50° Fahr. in summer the cereals will not grow and forest trees do not flourish. Inasmuch as within these so-called temperate zones there are very great variations of temperature and also of humidity, a better term for them would be "intermediate" zones.

The northern and southern extremities of the globe are called the North and South Pole Cap, and these lie north and south of

the isotherm of 50° Fahr. for the warmest month.

In each of these zones we may distinguish an Oceanic type and a continental type of climate, together with an intermediate type which we may call littoral and an extreme, or desert type. Again on the continents we can still further subdivide into a mountain and a plateau type. The differences between these types should easily be appreciated by the reader who has mastered the principles which have been discussed above, and it is hardly necessary here to point them out.

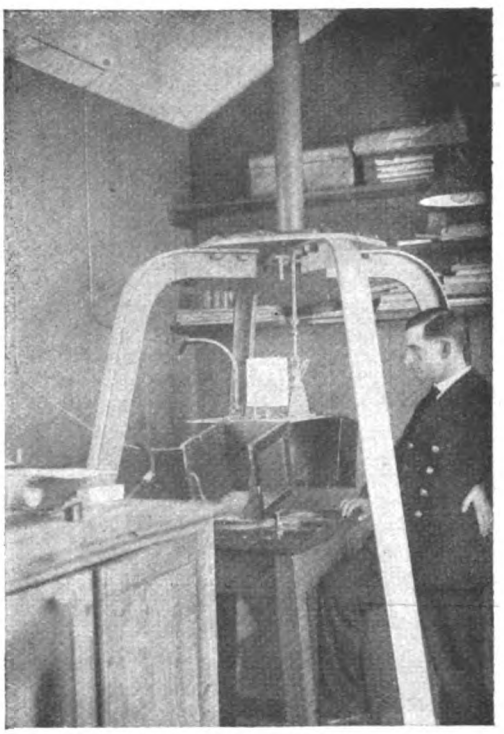
These differences of climate are the determining factor in the distribution of both plant and animal life. It is a matter of common knowledge to all of us that some plants grow well on dry soils, some

A WAR DEVELOPMENT—

Two officers of the R.A.F. working out an observation taken by the biograph at Felixstowe.

on marshy soils ; some will grow in warm situations when they would perish if transplanted to colder regions. And this dependence on the climate obtains equally with respect to animals, for these, if not actually herbivorous or vegetarian, at least prey on other animals which do obtain their food from plants. We will, however, deal first with plant life as delimited by geographical considerations.

It must be remembered, however, that although latitude is the main influence in determining temperature, etc., a somewhat parallel change is encountered vertically as we rise above sea-level. We thus get districts of high elevation, where even in



—ADAPTED TO PEACE.

The biograph registers the speed and direction of the wind by means of tubes and rods which run up through a mast.

tropical countries we find plants which, broadly considered, are characteristic of more temperate climes. With this fact borne in mind, we will proceed with a brief account of geographical distribution in the vegetable kingdom.

In the hot belt there are experienced very frequent and very heavy rains, often exceeding 70 inches in a year, and these, together with a continuously high temperature, allow, in the lowlands, an exceedingly rank growth of plant life. Here we get the dense forests of Central Africa and the Amazon basin of South America and the Malay peninsula with the East Indies. The most important plants from the economic point of view are the various rubber trees of the Congo, Brazil, and the East Indies, and important

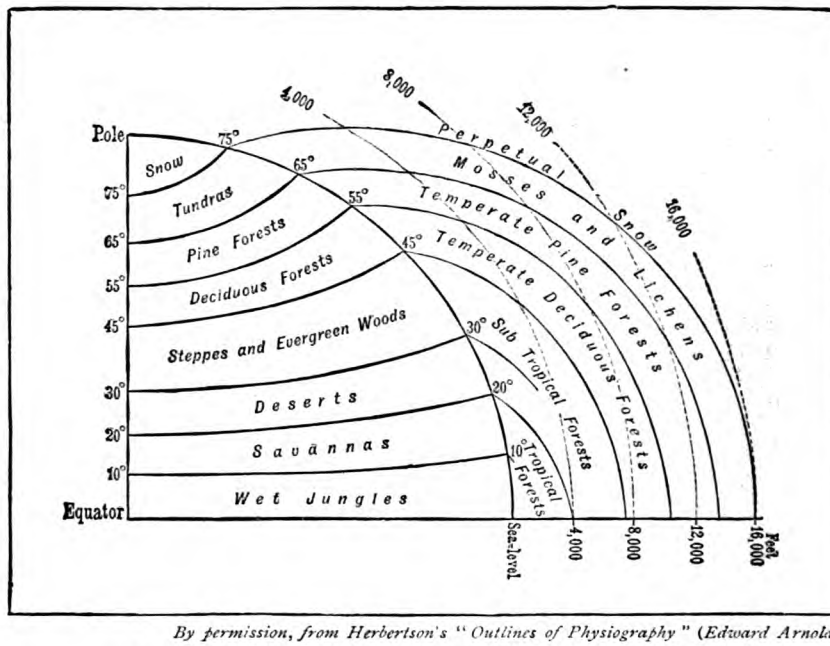
timber trees such as mahogany, teak, and rosewood. Where the forest has been cleared there are cultivated sago and oil palms, rice, arrowroot, sugar, coffee, cacao (the plant from which cocoa is made), banana and tobacco. Among the plants of little or no commercial value we find the characteristic creepers (lianas) of the tropical forests, and many varieties of orchids of beautiful forms and colours.

Between the tropical hot belt and the region of the trade winds we find extensive tracts of grassy lands in warm countries, with only a moderate rainfall. Such are the Savannas of South America, the Sudan in Africa, and the Australian Downs.

When we come to the region of the trade winds we find that a very large proportion of the land is desert. The vegetation is naturally scanty, and such as does exist is distinguished by modifications of structure that prevent the leaves from transpiring freely.

The plants characteristic of these desert regions are Cacti, species of Euphorbia, and Esparto grass. The leaves are succulent, leathery, or covered with wax, and are often very small, and even non-existent. In desert oases the Date Palm grows; and it is now believed that in a number of the Sahara oases there are oil-bearing strata, likely to prove of considerable economic worth.

A transition from the vegetation of the desert to the forests of the warm temperate regions is found in the subtropical scrub, or vegetation growing on the fringes of the desert regions of countries having a Mediterranean type of climate. It is in these parts that the resins and gums used in perfumery are found. In more watered sub-tropical parts grow grapes, oranges, figs, olives, oleander, and (in Australia) eucalyptus. Cotton likewise is a product of such regions.



By permission, from Herbertson's "Outlines of Physiography" (Edward Arnold).

VEGETATION ZONES OF LATITUDE AND ALTITUDE.

Although latitude is the main influence in determining temperatures, a somewhat parallel change is encountered as we rise vertically above sea level.

Northward and southward from the sub-tropical belts extending, as we have said above, to the isotherm of 50° F. for the warmest month, we get the forest region. The trees are either deciduous (i.e. those which shed their leaves yearly) or coniferous. Among the former class may be mentioned the oak, elm, ash, beech, and sycamore: the latter group include the pine, fir, and larch.

In the temperate zone also occur the grassy regions known as Steppes or Prairies. Such regions are less well watered than the forest regions, and are usually found to the leeward of them. It is these prairie lands that form the great cereal growing districts of the earth.

The principal wheat belts are to be found between latitudes 40° and 52° N. Oats will grow more to the northward than wheat, and maize requires a more southerly climate. In these climates we also get the potato, peas, beans, flax, beet, etc.

To the north of the temperate zone we find forests of coniferous trees, which gradually die away as the temperature becomes too cold, and give place to such regions as in Siberia are called the Tundra, which

extend to the Arctic Ocean. Vegetation is there very scanty.

When we come to discuss the geographical distribution of animals we are faced with a rather more complex set of phenomena. Nevertheless, as in the case of plants, we can divide up the globe into regions, but we notice here more pronounced than in the case of plants that the distribution is "discontinuous"; certain regions being separated from others by natural barriers such as a great mountain chain or a desert, or, more obviously, the ocean. In the case of both plants and animals, however, we may conclude that if on the region on both sides of any such barrier we find the same type, it is evident that at some time there was communication between them.

In order to group together regions of the earth in which the animals have most in common, zoologists have mapped it out into seven parts. The distribution of mammals has generally been taken as giving a convenient dividing line. These regions are (1) the Palæarctic (Europe, Asia, excluding India and South China, and Africa north of the Sahara); (2) the Ethiopian (Africa, south of the Sahara, Madagascar, and the south part of Arabia); (3) the Oriental (India, southern China, and part of the Malay archipelago); (4) the Australian (Australia, part of the Malay archipelago, and the Pacific Islands); (5) the Nearctic (North America as far south as Mexico); (6) the Neotropical (Central and South America, and the West Indies); (7) the New Zealand.

In the Palæarctic region we find the bison, elk, bear, sheep and beavers. The Nearctic region is very similar in its fauna or animal population, though there are some peculiar forms such as the skunk and racoon. In the Ethiopian region we have the large animals such as the elephant, rhinoceros, hippopotamus, giraffe, many antelopes, lion, leopard, panther, monkeys, crocodile and ostrich.

The Oriental region has many of the same animals as the Ethiopian, but of differing species; many deer are found, also squirrels, tigers (not found in Africa), cattle of various kinds, tapir, hyena, etc. The Australian region is characterised particularly by its marsupials or pouched animals such as the kangaroo and wombat, and monotremes, which are egg-laying mammals, and which are found nowhere else, such as the duck-billed platypus and the spiny ant-eater.

The New Zealand region has few native mammals, the wingless bird called the apteryx being perhaps the most characteristic of its indigenous animals. In the Neotropical region we find sloths, armadillos, llama, peccary, many rodents, no horses, sheep, goats or antelopes, many birds peculiar to itself, alligators and crocodiles.

C. J. S.

Photo: Underwood and Underwood.

AN OASIS IN THE DESERT.

The Sahara Desert is studded with such fertile spots, rich with date palms, and in many cases, it is now believed, containing oil-bearing strata.

Continued from page 236.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.

(M. A. Lewenz, M.A.[Lond.]).

ARITHMETIC.—XIII

103. An **Aliquot Part** of a number is a measure of the number, i.e. a part which when taken a certain number of times will exactly make up the given number.

Thus 3 is an aliquot part of 6, 9, 12, 15, 18, etc.

Practice is a convenient method of finding the cost or value of a given number of articles by means of aliquot parts, the value of 1 unit of any denomination being given.

Practice may be separated into two classes: (1) simple; (ii.) compound.

104. Simple Practice

In this case the given number is expressed in the same denomination as the unit whose value is given.

The method will be clear from the following examples.

Examples:—

(1) Find the cost of 5,984 articles at £2 6s. 8d. each.

Supposing each article cost £1, then total cost would be £5,984.

	£	s.	d.
Cost at £2 each = twice above sum .. .. =	11,968	0	0
Cost at **6s. 8d.** each = $\frac{1}{3}$ cost at £1 .. .. .. =	1,994	13	4
∴ cost at £2 6s. 8d. (adding columns) .. .. =	**£13,962**	**13**	**4**

(2) Find the cost of 3,825 things at £3 19s. 4d. each.

Cost at £1 = £3,825.

	£	s.	d.		£	s.	d.
Cost at	3	0	0	=	11,475	0	0
Cost at	0	10	0	= $\frac{1}{2}$ of cost at £1 =	1,912	10	0
Cost at	0	5	0	= $\frac{1}{2}$ of cost at 10s. =	956	5	0
Cost at	0	4	0	= $\frac{1}{5}$ of cost at £1 =	765	0	0
Cost at	0	0	4	= $\frac{1}{12}$ of cost at 4s. =	63	15	0
Cost at	3	19	4	=	**£15,172**	**10**	**0**

We might also proceed as follows:

Cost at £1 = £3,825.

	£	s.	d.
Cost at £4 =	15,300	0	0
Cost at 8d. = $\frac{1}{80}$ of cost at £1 =	127	10	0
Cost at £3 19 4 (subtracting vertical columns) .. .. =	**£15,172**	**10**	**0**

It is very essential to recognise the aliquot parts of £1 quickly. No one is likely to overlook the fact that 10s. = $\frac{1}{2}$ of £1, that 5s. = $\frac{1}{4}$ of £1, and so on, but the following are not always quickly recognised: 6s. 8d. = $\frac{1}{3}$, 3s. 4d. = $\frac{1}{6}$, 2s. 6d. = $\frac{1}{8}$, 1s. 8d. = $\frac{1}{12}$, 1s. 4d. = $\frac{1}{15}$, 1s. 3d. = $\frac{1}{16}$, 10d. = $\frac{1}{24}$, 8d. = $\frac{1}{30}$, 6d. = $\frac{1}{40}$.

Where we have a fraction of a penny or of a farthing, it is usual to give the result to the nearest penny or farthing, as the case may be.

Where the shillings and pence in the price are nearly a full sovereign, it is usually better to take the price at £1 more than the actual number of full pounds, and then subtract the necessary amount. This has been done in the second method of working Example (2) above.

105. Compound Practice

In this case the given number is not wholly expressed in the same denomination as the unit for which the price is given.

Examples:—

(1) Find the value of 84 cwt. 3 qr. 14 lb. at £3 9s. 8d. a cwt.

1 cwt. costs £3 9s. 8d.

	£	s.	d.
7 cwt. = 7 × 1 cwt. cost ..	24	7	8
84 cwt. = 12 × 7 cwt. cost ..	292	12	0
3 qr. 14 lb. = $\frac{1}{8}$ of 7 cwt. cost	3	0	11½
84 cwt. 3 qr. 14 lb. cost ..	**£295**	**12**	**11½**

(2) Find the cost of 76 ac. 3 ro. 8 sq. po. at £3 7s. 4d. an acre.

1 ac. costs £3 7s. 4d.

10 ac. cost £33 13s. 4d.

	£	s.	d.
70 ac. .. .. .. cost	235	13	4
6 ac. .. .. ,,	20	4	0
76 ac. .. .. .. ,,	255	17	4
2 ro. = $\frac{1}{2}$ ac. .. .. ,,	1	13	8
1 ro. = $\frac{1}{2}$ of 2 ro. .. .. ,,	0	16	10
8 sq. po. = $\frac{1}{6}$ of 1 ro. .. ,,	0	3	$4\frac{2}{3}$
76 ac. 3 ro. 8 sq. po. .. ,,	£258	11	$2\frac{2}{3}$

= **£258 11s. 2d. to the nearest penny**

106. It is often useful to use aliquot parts of larger sums than £1, as this saves time and trouble. The aliquot parts of £10, £100, and £1,000 should be remembered.

$\frac{1}{3}$ of £10 = £3 6s. 8d.
$\frac{1}{4}$ of £10 = £2 10s.
$\frac{1}{6}$ of £10 = £1 13s. 4d.
$\frac{1}{8}$ of £10 = £1 5s.
$\frac{1}{12}$ of £10 = 16s. 8d.
$\frac{1}{15}$ of £10 = 12s. 6d.
$\frac{1}{24}$ of £10 = 8s. 4d.

Similarly—

$\frac{1}{3}$ of £100 = £33 6s. 8d
$\frac{1}{4}$ of £100 = £25.
$\frac{1}{6}$ of £100 = £16 13s. 4d.
$\frac{1}{8}$ of £100 = £12 10s.
$\frac{1}{12}$ of £100 = £8 6s. 8d.
$\frac{1}{16}$ of £100 = £6 5s.
$\frac{1}{24}$ of £100 = £4 3s. 4d.

And—

$\frac{1}{3}$ of £1,000 = £333 6s. 8d.
$\frac{1}{4}$ of £1,000 = £250.
$\frac{1}{6}$ of £1,000 = £166 13s. 4d.
$\frac{1}{8}$ of £1,000 = £125.
$\frac{1}{12}$ of £1,000 = £83 6s. 8d.
$\frac{1}{16}$ of £1,000 = £62 10s.
$\frac{1}{24}$ of £1,000 = £41 13s. 4d.

Examples:—

(1) 479 articles at £3 6s. 8d. cost $£\frac{10}{3} \times 479$

$= £\frac{4,790}{3}$ = **£1,596 13s. 4d.**

(2) 5,786 articles at £41 13s. 4d. cost

$£\frac{1,000}{24} \times 5,786 = £\frac{5,786,000}{24} = £\frac{723,250}{3}$

= **£241,083 6s. 8d.**

107. Since 1 shilling equals 12 pennies, it is clear that **in reckoning the price of articles by the dozen,** every penny in the price of a single article will be a shilling in the price of a dozen. Hence, when we reckon prices per dozen, we need only express the price of a single article in pence, and then call every penny a shilling, every farthing 3d., every halfpenny 6d., and every three-farthings 9d.

Examples:—

(1) Find the price of a dozen articles at 2s. 7d. each.

2s. 7d. = 31d. ∴ a dozen cost **31s.**

(2) Find the price of a dozen articles at 1s. $8\frac{3}{4}$d. each.

1s. $8\frac{3}{4}$d. = $20\frac{3}{4}$d. ∴ a dozen cost 20s. 9d. = **£1 0s. 9d.**

Since a gross equals 12 dozen, we have to perform this process twice to find the price per gross.

Example:—

Find the price per gross of articles costing $2\frac{1}{2}$d. each.

The price per dozen will be 2s. 6d. = 30d.
∴ the price per gross will be 30s. = **£1 10s. 0d.**

Conversely, to find the price per article when given the price per dozen, we need only call the shillings pence, and divide the pence by 12.

Thus, find the price of an article costing £3 5s. 9d. per dozen.

£3 5s. 9d. = 65s. 9d. ∴ price of each article = $65\frac{3}{4}$d. = **5s. $5\frac{3}{4}$d.**

To find the price per article, given the price per gross, we call the shillings pence and then divide by 12.

Thus, find the price of an article costing £2 17s. per gross.

£2 17s. = 57s. ∴ price per dozen = 57d.

∴ price per article = $\frac{57}{12}$d. = **$4\frac{3}{4}$d.**

108. In a similar way **the price of a score of articles** is found by calling the shillings in the price of a single article, pounds (since £1 = 20s.).

Thus, to find the price per score of an article costing 3s. 8d.

3s. 8d. = $3\frac{2}{3}$s. ∴ price per score = £$3\frac{2}{3}$
= **£3 13s. 4d.**

2d., 3d., 4d., 6d., 8d., 9d., and 10d. can all be expressed as fractions of a shilling whose values are readily expressed when treated as fractions of a pound.

Thus, find the price of 20 articles at 7s. 10d. each.

7s. 10d. = $7\frac{5}{6}$s. ∴ price per score = £$7\frac{5}{6}$
= **£7 16s. 8d.**

If we have other numbers of pence, we take the nearest of the above numbers of pence, express the difference in farthings, and call each farthing 5d. (since 20 farthings = 5d.).

Thus, find the cost per score of articles costing 16s. $5\frac{1}{2}$d. each.

16s. $5\frac{1}{2}$d. = 16s. 4d. + 6 farthings = $16\frac{1}{3}$s. + 6 farthings.

∴ price per score = £$16\frac{1}{3}$ + 5 × 6d.
= £16 6s. 8d. + 2s. 6d. = **£16 9s. 2d.**

Or we proceed thus—

16s. $5\frac{1}{2}$d. = 16s. 6d. — 2 farthings = $16\frac{1}{2}$s. — 2 farthings.

∴ price per score = £$16\frac{1}{2}$ — 10d.
= £16 10s. — 10d. = **£16 9s. 2d.**

Exercise 36

Find the value of—

(1) 454 things at 2s. 9d. each; and 626 things at 8s. 8d. each.

(2) 1,875 things at 2s. 6d. each; and 3,842 things at £7 12s. 6d. each.

(3) 51,143 things at £4 17s. $9\frac{1}{4}$d. each.

(4) $1,846\frac{1}{4}$ things at £6 12s. 6d.

(5) 60 cwt. 3 qr. 12 lb. at £7 13s. 6d. per cwt.

(6) 132 ac. 3 ro. 25 sq. po. at £3 7s. 4d. an acre.

(7) 22 qr. 4 bush. 3 pk. at 5s. $8\frac{1}{4}$d. per bush.

Exercise 37

The following are taken from questions set at the London Matriculation Examination:—

(1) The average cost of travelling in England is 0·85 pence per mile, and the charge for excess luggage is 6d. per fifty pounds for every hundred miles travelled. Express these statements in centimes per kilometre and centimes per 50 kilogrammes for every hundred kilometres travelled, giving the results correct to three significant figures.

A metre = 1·0936 yd.; 100 centimes = 9·525 pence; a kilogramme = 2·205 lb.

(2) The five left-hand significant figures in the product of 0·013057 and 23·7814 are given in a table of products as 31051. How many more significant figures would be required to give the exact product? Write down the product correct to three places of decimals.

Find to two places of decimals the remainder when 4·37214 is divided by 0·257819.

(3) Express $\frac{\cdot 37816546}{\cdot 92308710}$ as a decimal correct to four significant figures.

If an alloy is made with 378·17 kilogrammes of zinc and 544·92 kilogrammes of copper, find, to the nearest integer in each case, the number of parts of zinc and copper in 100 parts by weight of the alloy.

(4) 2,987,750 $\frac{1}{2}$-kilogrammes of tobacco are shipped in 16,890 bales. Find to the nearest tenth of a cwt. the average weight of a bale, a kilogramme being equivalent to 2·2046 lb.

If the tobacco is sold at 203·76 cents per half-kilogramme, find to the nearest penny the price per lb. in English money, taking £1 = 1208$\frac{13}{16}$ cents.

(5) When the price of butter is 1s. 8d. per lb., find the cost in francs of 25 kilogrammes. If the price per lb. falls one penny, how much more can be bought for the same number of francs as was paid for 25 kilogrammes in the first instance?

1 lb. = 453·6 grammes; 25 francs = £1.

Key to Exercise 34

(1) $\frac{11}{14}$. (2) $\frac{21}{20}$. (3) $\frac{24}{27}$. (4) $\frac{40}{9}$.

(5) In descending order of magnitude: $\frac{5}{6}$ of a guinea, $\frac{5}{6}$ of 14s. 7$\frac{1}{2}$d., $\frac{5}{8}$ of £1.

(6) $\frac{1}{20}$ of a day is greater by 3 min.

(7) £1·43851.

(8) ·6825, ·000125. (9) ·002. (10) ·62963 yards.

(11) ·02539....

Key to Exercise 35

(1) $\frac{15}{33}\frac{5}{4}$. (2) 3s. 9$\frac{1}{4}$d. per lb.; or 2$\frac{3}{4}$d. per oz.

(3) The tank is filled at 15$\frac{1}{2}$ minutes past noon. A has made 47 journeys, B 38, and C 32, counting in the first journey which each must have made to reach the tank at noon. C poured last, and had 2$\frac{1}{2}$ gallons to spare.

(4) (i.) 5·860, 28·698, 8·540, 1·156, ·035.
(ii.) 5·86, 28·7, 8·54, 1·16, ·0346.

(5) (i.) 39743000000; (ii.) 0·025; (iii.) 3·83.

(6) 22 kilogrammes per square metre.

M. A. L.

ALGEBRA.—XIII

89. Solution of problems by means of equations.

A simple problem leading up to an equation has already been given. We shall now give examples of a few more complicated ones.

In every problem that can be solved algebraically, certain facts or data are given; these are called the **constants.** The unknown quantity or quantities which have to be found are called the **variables.**

Examples:—

(1) An integer of 2 digits, the sum of which is 5, exceeds the integer represented by the same digits reversed by 9. Find the integer.

Let the digit in the tens place be x.

Then the digit in the units place will be $(5 - x)$.

The integer in question may be represented by $10x + (5 - x)$.

The integer which has the same digits reversed will be represented by $10(5 - x) + x$.

The condition of the problem is therefore represented by the equation:

$$10x + (5 - x) = 10(5 - x) + x + 9$$
$$\therefore 9x + 5 = -9x + 59$$
$$\therefore 18x = 54 \quad \therefore x = 3$$

Since $x = 3$, $5 - x = 2$ and $\therefore$ the required integer is 32.

The student may easily see for himself that this integer satisfies the given condition.

(2) A sum of £8 was paid in half-crowns, shillings and sixpences. There were 120 coins altogether, and twice as many half-crowns as shillings. How many coins of each kind were used?

Let x be number of shillings used
then $2x$ is ,, ,, half-crowns ,,
and $140 - x - 2x$ is ,, sixpences ,,

Since one shilling = 2 sixpences, a half-crown = 5 sixpences, and £8 = 320 sixpences, the condition of the problem is represented by the equation

$$2x + 5 \times 2x + (140 - x - 2x) = 320$$
$$\therefore 9x = 180$$
$$\therefore x = 20$$

Hence 20 shillings, 40 half-crowns, and 80 sixpences were used.

(3) A and B start a yards apart. The length of A's stride is to the length of B's stride as b is to c; A takes d steps while B takes e; if they run towards each other, where will they meet?

Let x be number of yards A goes till they meet, B will take $\frac{e}{d}$ times number of steps A takes and length of B's stride $= \frac{c}{b}$ of A's stride

$\therefore$ while A goes x yards, B will go $\frac{e}{d}$ of $\frac{c}{b}$ of x yards

$\therefore$ the conditions of the problem are expressed by equation $x + \frac{e}{d} \times \frac{c}{b} \times x = a$

$$\therefore x\left(\frac{bd + ce}{bd}\right) = a$$
$$\therefore x = \frac{abd}{bd + ce} \text{ yards}$$

$\therefore$ they meet $\frac{abd}{bd + ce}$ yards from A's starting point.

(4) The difference between 2 numbers is 7, and their product is 18. What are the numbers?

Let x be the greater number
then $(x - 7)$ is the lesser number.

By the conditions of the problem

$$x(x - 7) = 18$$
$$\therefore x^2 - 7x - 18 = 0$$
$$\therefore (x - 9)(x + 2) = 0$$
$$\therefore x = 9 \text{ or } x = -2.$$

rejecting the negative solution, we have $x = 9$ and the other number = 2.

(5) From a regiment of soldiers a solid square is formed leaving $c^2 + pc$ men over, where c and p are positive integers. To form a square with c more men in the side would require pc more men than there are in the regiment. How many men are there in the regiment?

Let x be number of men in the side of the square originally formed.

Then number of men in the regiment $= x^2 + c^2 + pc$. The number of men required to form a square with c more men in the side $= (x + c)^2$.

Hence $(x + c)^2 = x^2 + c^2 + pc + pc$
$$\therefore 2cx = 2pc \quad \therefore x = p$$
$\therefore$ number of men in regiment $= p^2 + pc + c^2$.

(6) Two men A and B engage to mow certain fields in 12 days, but after 8 days they have to engage a third man C with whose help the work is just finished in time. The rates of working of A, B and C are in the ratios 5 : 4 : 3. Find how long the work would have taken if all three had

started together. (*London Matriculation Examination.*)

Let x be number of acres A mows in 1 day

then $\frac{4x}{5}$ is „ „ B „ „

and $\frac{3x}{5}$ is „ „ C „ „

A worked 12 days, B worked 12, and C worked 4 days

$\therefore$ total number of acres mown

$$= 12x + \frac{4}{5} \times 12x + \frac{3}{5} \times 4x$$

$$= \frac{120}{5}x = 24x \text{ acres.}$$

If all three worked together they would mow $\frac{12}{5}x$ acres in 1 day

$\therefore$ they would mow $\frac{120}{5}x$ acres in $\frac{120}{5}x \div \frac{12}{5}x = 10$ days.

90. Equations of a higher degree than the second.

The majority of such equations we are not able to solve, but certain forms are capable of solution.

Equations of the same form as quadratic equations.

The equation $ax^4 + bx^2 + c = 0$ can be solved in the same way as the quadratic equation $ax^2 + bx + c = 0$;

and we consequently have

$$x^2 = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

Hence $x = \pm\sqrt{\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}}$.

Thus there are *four* real or imaginary roots according to the sign taken before the root sign. Similarly **any equation in which the unknown quantity occurs in only two terms can be reduced to two alternative equations,** provided that the power to which the unknown quantity occurs in one term is the square of the power to which it occurs in the other term, for $aP^2 + bP + c = 0$ is equivalent to

$$P = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Examples :—

(1) Solve $x^4 - 5x^2 + 4 = 0$.

We have $(x^2 - 4)(x^2 - 1) = 0$

$\therefore x^2 = 4$ and hence $x = \pm 2$

or $x^2 = 1$ and hence $x = \pm 1$.

Thus we obtain 4 solutions, $+1, -1, +2, -2$.

(2) Solve $x^4 - 15x^2 + 10x + 24 = 0$

We have $(x^4 - 15x^2 + 14) + 10(x + 1) = 0$

$\therefore (x^2 - 1)(x^2 - 14) + 10(x + 1) = 0$

$\therefore (x + 1)\{(x - 1)(x^2 - 14) + 10\} = 0$

$\therefore (x + 1)\{x^3 - x^2 - 14x + 24\} = 0$

$\therefore (x + 1)(x - 2)(x^2 + x - 12) = 0$

$\therefore (x + 1)(x - 2)(x - 3)(x + 4) = 0$

hence $x = -1$ or 2 or 3 or -4.

91. When one root of an equation can be found by inspection, the degree of the equation may be lowered.

Example :—

$(a - x)^3 + (b - x)^3 = (a + b - 2x)^3$.

The equation is clearly satisfied by $x = a$ and $x = b$.

$\therefore (x - a)(x - b)$ will divide exactly the expression $(a - x)^3 + (b - x)^3 - (a + b - 2x)^3$ and the remaining factor, since it must be of the first degree, when equated to zero, will give the third root of the equation.

Or we may proceed as follows:

The equation may be written

$$(a - x)^3 + (b - x)^3 = \{(a - x) + (b - x)\}^3$$

$$= (a - x)^3 + 3(a - x)^2(b - x) + 3(a - x)(b - x)^2 + (b - x)^3$$

$\therefore 3(a - x)^2(b - x) + 3(a - x)(b - x)^2 = 0$

$\therefore (a - x)(b - x)(a + b - 2x) = 0$

$\therefore$ the roots of the equation are

$$x = a, x = b, x = \frac{a + b}{2}.$$

92. A **reciprocal equation** is one in which the coefficients are the same whether read from left to right or in reverse order; or in which the coefficients when read from left to right all differ in sign from the coefficients read in reverse order.

Thus $ax^3 + bx^2 + bx + a = 0$

$ax^4 + bx^3 + cx^2 + bx + a = 0$

$ax^5 - bx^4 + cx^3 - cx^2 + bx - a = 0$

are reciprocal equations.

Examples :—

(1) $ax^3 + bx^2 + bx + a = 0$

we have $a(x^3 + 1) + bx(x + 1) = 0$

$\therefore (x + 1)\{a(x^2 - x + 1) + bx\} = 0$

$\therefore x = -1$, or $ax^2 + (b - a)x + a = 0$

and $\therefore x = \frac{(a - b) \pm \sqrt{(b - a)^2 - 4a^2}}{2a}$.

(2) $ax^4 + bx^3 + cx^2 + bx + a = 0$

Dividing by x^2 we have

$$a\left(x^2 + \frac{1}{x^2}\right) + b\left(x + \frac{1}{x}\right) + c = 0.$$

Now put $x + \frac{1}{x} = X$

then $x^2 + \frac{1}{x^2} = X^2 - 2$.

Hence $a(X^2 - 2) + bX + c = 0$.

If the two roots of this quadratic in X be α and β then the roots of the original equation will be the four roots of the equations

$$x + \frac{1}{x} = \alpha \text{ and } x + \frac{1}{x} = \beta.$$

(3) $ax^5 - bx^4 + cx^3 - cx^2 + bx - a = 0$.

We have $a(x^5 - 1) - bx(x^3 - 1) + cx^2(x - 1) = 0$

$\therefore (x - 1)\{a(x^4 + x^3 + x^2 + x + 1) - bx(x^2 + x + 1) + cx^2\} = 0$.

Hence $x = 1$ or $a(x^4 + x^3 + x^2 + x + 1) - bx(x^2 + x + 1) + cx^2 = 0$.

This is an equation of the fourth degree and is solved as in Example 2.

93. Binomial Equations. The general form of these is $x^n \pm k = 0$.

Examples :—

(1) $x^3 - 1 = 0$.

We have $(x - 1)(x^2 + x + 1) = 0$

$\therefore x = 1$ or $x^2 + x + 1 = 0$

and hence $x = \dfrac{-1 \pm \sqrt{-3}}{2}$.

Thus we have 3 roots of the equation $x^3 - 1 = 0$, that is, *three cube roots of unity*, and they are

$1, -\frac{1}{2} + \frac{\sqrt{-3}}{2}$ and $-\frac{1}{2} - \frac{\sqrt{-3}}{2}$.

(2) $x^4 - 1 = 0$

We have $(x - 1)(x + 1)(x^2 + 1) = 0$

hence the four fourth roots of unity are :

$1, -1, +\sqrt{-1}, -\sqrt{-1}$

Exercise 17

(1) The difference between two numbers is 8 ; if 2 be added to the greater the result will be three times the smaller ; find the numbers.

(2) A man left half his estate to his wife, one-ninth to each of his 4 children, and the residue, amounting to £360, to a charitable institution. What was the value of his estate ?

(3) The length of a room exceeds its breadth by 3 feet ; if the length had been increased by 3 feet and its breadth diminished by 2 feet the area would not have been altered ; find the dimensions.

(4) A and B played 3 games. They started with certain sums of money ; B having £12 more than A. In each game A and B each staked half the money in his possession at the beginning of that game. A won in the first two games and lost in the third. Finally B was left with £21. How much had each at first ?

(5) A battalion of soldiers when formed into a solid square presents sixteen men fewer than when formed into a hollow square four deep. Find the number of men in the battalion.

(6) It is between 5 and 6 o'clock, and it is observed that the number of minute spaces between the hands is to the number of spaces 10 minutes later, as 114 : 169. What is the time ?

Exercise 18

Solve the following equations—

(1) $x^6 + 7a^3x^3 - 8a^6 = 0$.

(2) $(x^2 + x + 1)(x^2 + x + 2) = 56$.

(3) $x^4 - 2(a + b)x^2 + a^2 + 2ab + b^2 = 0$.

(4) $(a - x)^4 + (b - x)^4 = (a + b - 2x)^4$.

(5) $x^5 + 1 = 0$. (6) $x^4 + 7x^3 - 7x - 1 = 0$.

(7) $x^6 - 1 = 0$. (8) $(m - x)^5 + (x - n)^5 = (m - n)^5$.

Key to Exercise 14

(1) $-25, 1$. (2) $9, -4$. (3) $4, -17$. (4) $\frac{15}{8}, -2$.

(5) $2, -\frac{11}{6}$. (6) $\frac{5}{8}, -3$. (7) $b, -(b + 1)$. (8) a, b.

Key to Exercise 15

(1) 8. (2) 5. (3) 4. (4) $b - a$. (5) $\dfrac{b + a}{2}$.

(6) $\dfrac{a^2c + b^2a + c^2b - 3abc}{a^2 + b^2 + c^2 - bc - ca - ab}$. (7) $0, -\frac{5}{2}$.

(8) $\dfrac{3(b - c)(c - a)(a - b)}{(b - c)^2 + (c - a)^2 + (a - b)^2}$.

(9) $0, \frac{1}{26}(-19 \pm \sqrt{-3})$.

Key to Exercise 16

(1) 16. (2) 0, $a^2 - b^2$. (3) 0. (5) 0 or $-\frac{36}{11}$.

M. A. L.

GEOMETRY.—XII

We have hitherto dealt with straight lines; we must now consider some of the properties of circles.

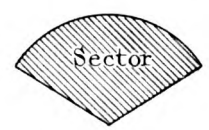
Definitions.—Any part of the circumference of a circle is called an *arc*.

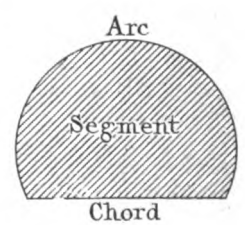
The straight line joining any two points on the circumference of a circle is called a *chord*.

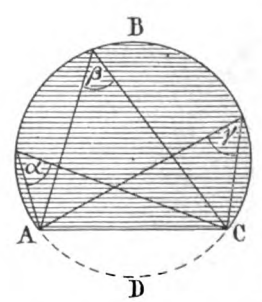
Any part of a circle cut off by a chord is called a *segment*.

Any part of a circle bounded by two radii and an arc is called a *sector*.

Angles formed by lines drawn from any point in the arc to the ends of the chord which cuts off a segment are called *angles in the segment*. They are said to *stand on the arc* cut off below the segment, or to be *subtended by* it.







Thus α, β, γ are angles in the segment A B C and they stand on the dotted arc A D C.

Circles which have the same centre are said to be *concentric*.

The following theorems are obviously true and may easily be shown to be true by practical experiment.

1. *A circle cannot have more than one centre.*

(*If a circle had two centres the chord which passed through them both would have two middle points.*)

2. *Two concentric circles cannot meet or cut one another.*

(*If their radii be equal they will coincide completely ; and if their radii be unequal, every point on the circumference of that circle which has the greater radius lies outside the other circle.*)

3. *If two circles have equal radii they are equal in all respects.*

4. *If two circles are equal in area their radii are equal.*

When each of the vertices of a rectilineal figure lies on a side of a second rectilineal figure, the first figure is said to be *inscribed in* the second, and the second is said to be *described about* the first.

Similarly, when each vertex of a rectilineal figure lies on the circumference of a circle, the figure is said to be *inscribed in* the circle, and the circle is said to be *described about* the figure.

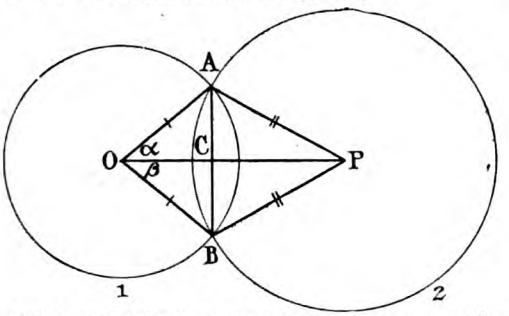
(The circle is also called the *circumscribed* circle.)

And when each side of a rectilineal figure touches a circle, the figure is said to be described about the circle, and the circle is inscribed in the figure.

A figure is said to be *symmetrical* about a line if, when the figure is folded about the line, the part on one side of it coincides with the part on the other side of it.

Proposition 61.—Theorem

If two circles intersect, the line joining their centres bisects their common chord at right angles.



Let 1 and 2 be two ○s intersecting at A and B having centres O and P respectively.

Let O P cut A B at C.

It is required to prove that O P bisects A B at rt. ∠s at C.

Join O A, O B, P A, P B.

Proof.—In △s A O P, B O P

O A = O B, P A = P B (radii of same ○), O P is common } ∴ △ A O P ≡ △ B O P (Prop. 8).

∴ α = β.

In △s A O C, B O C

O A = O B, P A = P B (radii of same ○), O C is common } ∴ △ A O C ≡ △ B O C (Prop. 5).

included ∠ α = included ∠ β

∴ A C = B C and ∠ O C A = adjacent ∠ O C B, i.e. each is a rt. ∠

∴ O P bisects A B at rt. ∠s.

Proposition 62.—Theorem

1. *If a diameter of a circle bisect a chord which is not a diameter, the diameter is at right angles to the chord.*

2. **Converse.**—*If a diameter be at right angles to a chord which is not a diameter, the diameter bisects the chord.*

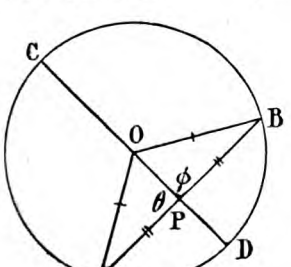
1. Let diameter C D bisect chord A B at P.

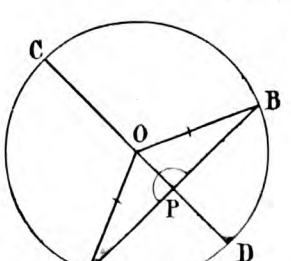
It is required to prove that C D is ⊥ to A B.

Proof.—Join A and B to the centre O.

In △s A O P, B O P

A O = B O (radii), A P = B P (hypothesis), O P is common } ∴ △ A O P ≡ △ B O P (Prop. 8).





∴ θ = φ

but these are adjacent ∠s ∴ each is a rt. ∠

∴ C D is ⊥ to A B.

2. Let diameter C D cut chord A B at rt. ∠s.

It is required to prove that A P = B P.

Proof.—Join A and B to centre O.

In right-angled △s A O P, B O P

hypotenuse A O = hypotenuse B O (radii)

O P is common

∴ △ A O P ≡ △ B O P

∴ A P = B P.

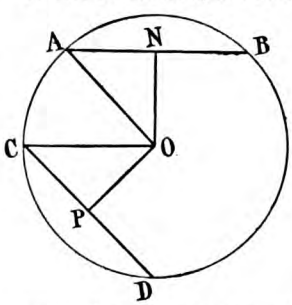
Corollary.—*Two chords of a circle which do not both pass through the centre cannot bisect each other.*

Proposition 63.—Theorem

1. *Equal chords of a circle are equally distant from the centre.*

2. **Converse.**—*Chords which are equidistant from the centre are equal.*

1. Let chords A B, C D be equal.



It is required to prove that ⊥ O N from centre O = ⊥ O P.

Proof.—Join O A, O C.

∵ O N is ⊥ to A B ∴ N is middle pt. of A B

∵ O P is ⊥ to C D ∴ P is middle pt. of C D (Prop. 62).

Now A B = C D (hypothesis)

∴ A N = C P

In right-angled △s A O N, C O P

hypotenuse O A = hypotenuse O C (radii)

A N = C P

∴ △ A O N ≡ △ C O P ∴ O N = O P.

2. Let ⊥ O N on chord A B = ⊥ O P on chord C D.

It is required to prove that A B = C D.

Proof.—In right-angled △s A O N, C O P.

hypotenuse O A = hypotenuse O C (radii).

O N = O P (hypothesis)

∴ △ A O N ≡ △ C O P

∴ A N = C P ∴ 2 A N = 2 C P ∴ A B = C D.

Proposition 64.—Theorem

1. *If one chord of a circle is nearer the centre than another, then the chord nearer the centre is the greater.*

2. **Converse.**—*If one chord of a circle is greater than another, the greater chord is nearer the centre.*

3. *A diameter is greater than any chord which does not pass through the centre.*

1. Let the ⊥ O P from the centre to the chord C D be > ⊥ O N from the centre to the chord A B.

It is required to prove that A B > C D.

Proof.—Join B and D to centre O.

∵ O N B is a rt. ∠d △

O B² = O N² + N B² (Prop. 59).

∵ O P D is a rt. ∠d △

O D² = O P² + P D² (Prop. 59).

Now O B² = O D² (radii)

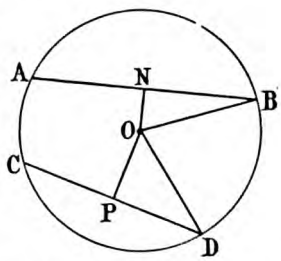
∴ O N² + N B² = O P² + P D².

Now $OP^2 > ON^2$ ($\because OP > ON$)
$\therefore PD^2 < NB^2$
$\therefore PD < NB$

Also ON and OP bisect AB and CD at N and P (Prop. 62).

$\therefore CD < AB$, i.e. $AB > CD$.

2. Let the chord AB be greater than the chord CD.



It is required to prove that the $\perp$ ON from the centre on $AB < \perp$ OP from the centre on CD.

Proof. — ON and OP bisect AB and CD (Prop. 62).

$\therefore NB > PD$.

Now $OB^2 = ON^2 + NB^2$ and $OD^2 = OP^2 + PD^2$ (Prop. 59).

$\therefore ON^2 + NB^2 = OP^2 + PD^2$.

But $NB^2 > PD^2$ ($\because NB > PD$).

$\therefore ON^2 < OP^2$

$\therefore ON < OP$.

3. The two radii drawn to the ends of a chord are together greater than the chord since the chord and the radii form a $\triangle$ (Prop. 12).

$\therefore$ any diameter $>$ the chord.

Proposition 65.—Theorem

In a circle the angle at the centre which stands on any arc is double of the angle at the circumference standing on the same arc.

Let θ be the $\angle$ at the centre O, and let φ be the $\angle$ at the circumference P, standing on the same arc AB.

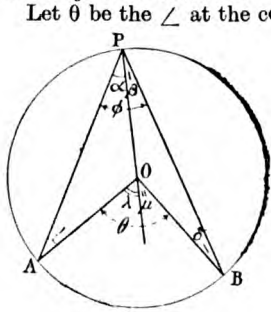


Fig. *a*.

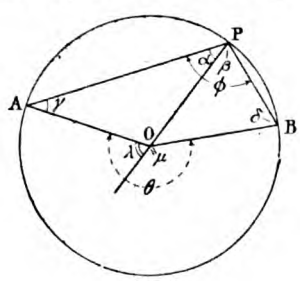


Fig. *b*.

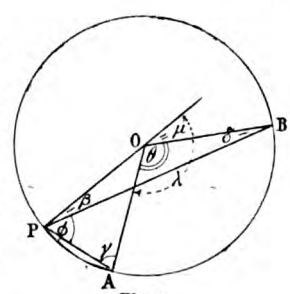


Fig. *c*.

It is required to prove that $\theta = 2\varphi$.

Proof.—Join PO.

PO may lie (1) between PA, PB (*see* Figs. *a* and *b*)

or (2) not between PA, PB (*see* Fig. *c*).

1. Produce PO, making the external $\angle$s λ and μ to $\triangle$s AOP, BOP then $\lambda = \alpha + \gamma$ and $\mu = \beta + \delta$ (Prop. 4, Cor. 3).

$\triangle$ AOP is isos. $\therefore \alpha = \gamma$
$\triangle$ BOP is isos. $\therefore \beta = \delta$ } (Prop. 6).

$\therefore \lambda = 2\alpha$ and $\mu = 2\beta$

$\therefore \theta = \lambda + \mu = 2\alpha + 2\beta = 2(\alpha + \beta) = 2\varphi$.

2. Produce PO, making the external $\angle$s λ and μ to $\triangle$s AOP, BOP (Fig. *c*).

$\lambda = \gamma + (\varphi + \beta)$
and $\mu = \beta + \delta$ } (Prop. 4, Cor. 3).

$\triangle$ AOP is isos. $\therefore \gamma = (\varphi + \beta)$
$\triangle$ BOP is isos. $\therefore \beta = \delta$ } (Prop. 6).

$\therefore \lambda = 2(\varphi + \beta)$ and $\mu = 2\beta$

$\therefore \lambda - \mu = 2(\varphi + \beta) - 2\beta = 2\varphi$

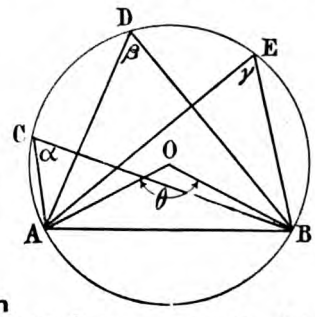
$\therefore \theta = 2\varphi$.

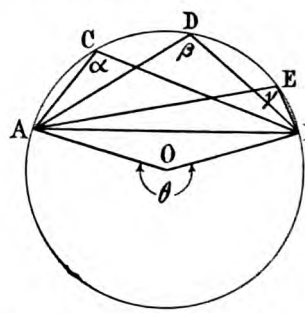
Proposition 66.—Theorem

All angles in the same segment of a circle are equal.

Let α, β, γ be $\angle$s in the segment ACB cut off by chord AB.

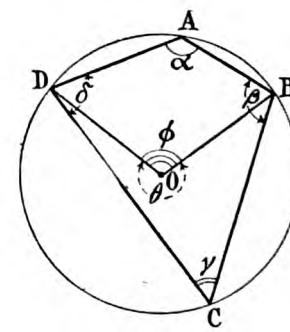
It is required to prove that $\alpha = \beta = \gamma$.





Proof.—Join A and B to centre O, making the $\angle\theta$.

$\theta = 2\alpha$
$\theta = 2\beta$
$\theta = 2\gamma$ } (Prop. 65) $\therefore \alpha = \beta = \gamma$.



Proposition 67.—Theorem

The sum of two opposite angles of a quadrilateral inscribed in a circle is equal to two right angles.

Let α, β, γ, δ be the $\angle$s of a quadrilateral inscribed in a circle.

It is required to prove that $\alpha + \gamma = 2$ rt. $\angle$s.

Proof.—Join D and B to the centre O.

$\theta = 2\alpha$
$\varphi = 2\gamma$ } (Prop. 65).

$\therefore \theta + \varphi = 2(\alpha + \gamma)$, but $\theta + \varphi = 4$ rt. $\angle$s.

$\therefore \alpha + \gamma = 2$ rt. $\angle$s.

Similarly $\beta + \delta = 2$ rt. $\angle$s.

Additional Theorem

One and only one circle can be drawn through three points which do not lie in a straight line.

Let ABC be three points not in a straight line.

It is required to prove that one and only one circle can be drawn passing through A, B and C.

Proof.—Join A B, B C.

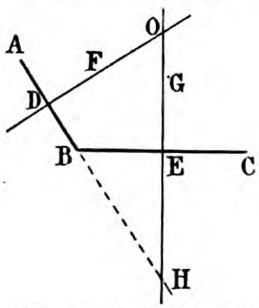
Bisect A B and B C at rt. ∠s by D F and E G.

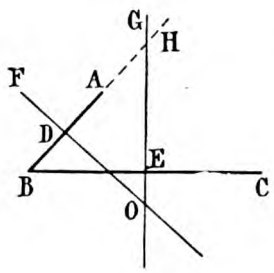
D F is not ‖ to E G.

For D F is ⊥ to A B and E G is ⊥ to B C, and D B C do not lie in a straight line

∴ D F and E G must meet.

Let them meet at O.





Now D F is the locus of points equidistant from A and B, and E G is the locus of points equidistant from B and C.

∴ pt. O, where the loci intersect, is equidistant from A, B and C, i.e. a ⊙ may be described with centre O and radius O A which will pass through A, B and C.

Suppose some other ⊙ can be drawn through A, B, C.

Let its centre be P.

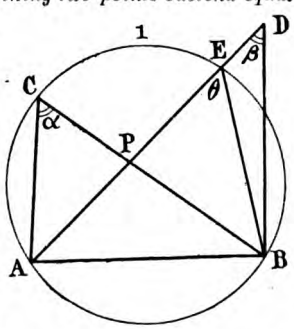
P must lie on D F ∵ P A = P B

and P must lie on E G ∵ P B = P C

∴ P can only lie at the one point O where D F and E G intersect.

Proposition 68.—Theorem (Converse of Proposition 66)

If the straight line joining two points subtend equal angles at two other points on the same side of it, then the four points are concyclic.



Let A B subtend equal ∠s α and β at C and D.

It is required to prove that A, C, D, B are concyclic (i.e. that they lie on the circumference of a ⊙).

Proof.—One of the lines C A, D A makes a greater ∠ with A B than the other.

∴ A D and B C intersect.

Let them intersect at P.

A circle can be described about △ A C B; let it be the ⊙ 1.

P is a point on the chord B C of the ⊙ 1 ∴ P lies within the ⊙ 1

∴ A P produced cuts the ⊙ 1 at some point.

Let it do so at E. Join E B.

Then (1) E coincides with D

(2) E is within P D

(3) E is beyond D.

If (2) were true, then

θ (ext. ∠ of △ B E D) > β (int. opp. ∠) (Prop. 4, Cor. 4).

But α = θ (Prop. 66).

∴ α > β, which is not the case.

Similarly, if (3) were true, then β would be the ext. ∠ of a △ of which θ would be an int. and opp. ∠, and consequently β would be > θ and

∴ β would be > α, which is not the case.

∴ (1) is true; i.e. A C, D B are concyclic.

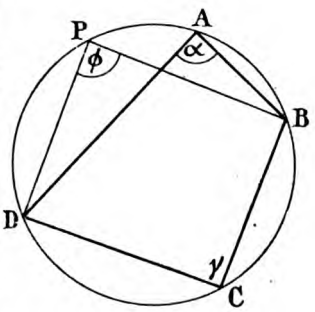
Proposition 69.—Theorem (Converse of Proposition 67)

If the sum of a pair of opposite angles of a quadrilateral be equal to two right angles, the quadrilateral is cyclic.

Let A B C D be a quadrilateral and let α + γ = 2 rt. ∠ s.

It is required to prove that A B C D is cyclic (i.e. that a ⊙ can be described passing through A B C D).

Proof.—A circle can be described about B C D.



Let P be a point on the circumference, not in the arc B C D.

Join P B, P D.

Then P B C D is a cyclic quadrilateral.

∴ φ + γ = 2 rt. ∠s (Prop. 67).

but α + γ = 2 rt. ∠s (hypothesis)

∴ φ = α

∴ D P A B are concyclic (Prop. 68),

i.e. A lies on a ⊙ passing through B, C, D,

i.e. A B C D is a cyclic quadrilateral.

Exercise 15

1. A O C, B O D are diameters of a circle A B C D. Show that A B and C D are parallel.

2. From the ends of a diameter A B of a circle, parallel chords A C, B D are drawn, meeting the circle again in C and D. Show that C D passes through the centre.

3. Through a given point on the circumference of a circle, two equal chords are drawn; show that they make equal angles with the line drawn from the given point to the centre.

4. Find the locus of the centre of a circle which passes through two given points.

5. Find the locus of the middle points of equal chords of a circle.

6. Determine the shortest chord that can be drawn through a given point inside a circle.

7. Through O on the side B C of an equilateral triangle A B C the straight lines O K, O L are drawn parallel to A B, A C respectively, to meet A C, A B respectively in K and L; and the circle through O, K and L cuts A B, A C again in points P and Q. Show that O P Q is an equilateral triangle.

Key to Exercise 13

1. 48·8 cm. 2. 16 in. 3. 25 miles. M. A. L.

From the picture by Margaret I. Dicksee, by permission of the British Art Co., Ltd.

HANDEL IN THE GARRET.

An incident in the childhood of a great German composer who spent much of his life in England, where he became naturalized. Handel (1685-1759), best known for his "Messiah" and other oratorios, was the son of a surgeon, who disapproved of music and did everything in his power to crush the boy's youthful genius. But a friend smuggled into the garret a clavichord (an instrument almost inaudible behind closed doors), and on this young Handel practised until one day he was discovered by his wrathful parent.

Continued from page 241.

ART AND MUSIC:

Contributors:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).

MUSIC.—II

MUSIC is such a universal and familiar art that we are justified in believing it possible, as in the case of speaking and writing, for everyone to acquire some proficiency in it. The success achieved will be in proportion to the amount of effort put forward and the time given to practice.

Does not natural capacity enter into the question? Yes, certainly; but perseverance in a right direction will to a great extent level up differences of natural equipment. This is, of course, speaking from the view point of performance. But there are other aspects of Music; and in regard to these phases, it is rare indeed to find a person to whom the appreciation of what is rightly called the Divine Art is a thing apart.

The man that hath no music in himself,
And is not moved by concord of sweet sounds,
Is fit for treasons, stratagems, and spoils.

* * * *

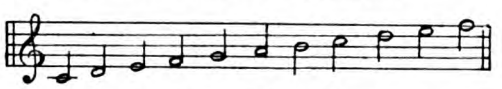
Let no such man be trusted.

Appreciation of Music

Human history proves, in all sorts of ways, that something in the emotional nature of man has always been capable of responding to a "concord of sweet sounds," though that concord has taken many different forms of expression amongst races and nations during the ages.

The appreciation of Music depends, in fact, upon a constant process of education. Shakespeare, with his fine contempt for the man with, as he thinks, no music in his soul, and himself charmed by the lute and the virginal, might possibly have found the appreciation of a modern orchestral symphony difficult. But in all times the advanced in Art have been impatient with those who lagged behind, and have severely stigmatised them.

Music was doubtlessly hindered in its development amongst the desirous public by the attitude of old Masters, who, with their airs of superiority and their arrogance chilled the interest of those who wished to learn. The most famous of the Fathers of Modern Music, the Italian Benedictine monk, Guy (Guido) of Arezzo, who lived in the eleventh century, and to whom we owe so much in regard to the rediscovery, invention, or development of the great ideas of the musical staff (or stave), the naming of the notes by letters of the alphabet, and the gamut of Do, re, mi, etc., was furiously impatient with his contemporaries.

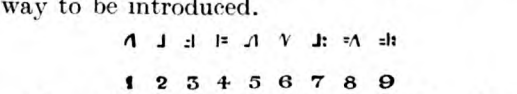


C D E F G A B C D E F

"How can a man," he said, "have the boldness to call himself a musician or a singer, if he cannot sing at once correctly a new tune?" He angrily denounced the singers and teachers of his day. The singers were told that their supposed praises of God sounded more like quarrelling amongst themselves, and the teachers were informed that "he who, like you, works without a plan, is more a stupid animal than a man." The teachers of the period of Guy of Arezzo worked without a plan because there was no plan for them.

Neumes and Notes

Instead of musical notes there were curious signs called "neumes," which were placed over the words to be sung. Neumes were a sort of musical shorthand, and were merely a guide to the memory. Music was taught "by ear," and there were no awkward intervals, neither was there "time" as we know it; though that was on the way to be introduced.



1 2 3 4 5 6 7 8 9

These signs perhaps look formidable; but in principle they are not difficult to under-

stand. The first one indicates that the singer was to raise an interval or more and descend again. The second meant a fresh note and an ascent. No. 6 is a descent and an ascent. No. 8 is two notes followed by an ascent and descent, and so on. These are only a very few of the combinations in use. The self-evident difficulty of getting a number of men and boys to sing together by means of such signs enables us to understand Guido's reference to "quarrelling rather than praising God."

Worth Striving After

But to return to the man whom our poetical young friend Lorenzo imagines "hath nc music in himself." I do not believe—or, rather, I would like not to believe—that such a person exists. At any rate, we can prove something.

Just shake your head a little rapidly from left to right.

You will, if the room in which you are be fairly quiet, hear a musical sound; you will perhaps be able, by humming or whistling gently, to get the pitch of the sound. Then go to the piano and strike the note A—the A a little above the lock plate. If your instrument is in good tune you will find that the sound you have heard in your ear, and the A of your piano, are practically

in unison. It is the note you hear when an orchestra is "tuning up." Thus you discover that you have what is called a musical ear, and that you carry about with you a sort of natural tuning-fork. You have the sense of "absolute pitch," about which some musical people make a fuss and a secret. Practice will greatly develop this sense.

There are some people who will tell you with apparent bland satisfaction, as though it marked a mind superior to trifles, that they "cannot tell one tune from another," and they will then proceed to disprove the truth of their statement by amplifying it with a remark something like: "Can't tell 'God save the King' from 'Annie Laurie.'" But the fact that they have discriminated between the two tunes is a refutation of their first statement. They are really not without a sense of music. They are only uninterested.

A man may even be deaf and a musician. Beethoven is an instance of one who, when deaf, was the composer of the world's heir-looms. This is not so extraordinary as it seems. For the writing and the appreciation of music are as much a function of the imagination as the writing of a poem or play. Perhaps the reason why composition, as distinct from the interpretation, of music is so rare compared with the other arts lies in a failure to realise this truth. So exclusive is the attention usually given to mastering the technique of a particular instrument that, more often than not, the student is unable to imagine the nature of a piece from the musical score. He must first *hear* it played by himself or by someone else. So long as his imagination lies thus dormant he cannot hope ever to compose.

Now it is a delightful thing to be a performer—even only a moderate one. To sketch or draw a portrait, to be able to make a little public speech appropriately and easily, to play on the violin or the piano attractively, to render the pianoforte accompaniment to a song or a violin solo at sight, and (perhaps above all in enjoyment) to sing a song to the approval of an audience—these are things worth striving after, and which thousands of persons succeed in doing.

Music has an advantage over other arts and accomplishments in the fact that it presents so many avenues of attractive investigation in which one may walk side by side with the great, and be musicians in spirit and truth, apart from such ability as one may possess or acquire as performers.

Mechanical Theory of Music

There is, for example, the Mechanical Theory of Music, the subject matter of which is very absorbing.

Music is really only noise, but noise brought thoroughly under control. The word "noise," in its derivation from Latin, has the same root as noxious; but just as many originally noxious, hurtful, or disagreeable things in Nature have been subdued to give us pleasure, so noise, or sound, has yielded up its secrets to be made into Music, and by this name it is classically associated with the Muses and Art.

It is wonderful, but quite true, that such familiar noises as the report of a gun, the crack of a whip, the clang of a hammer, the rumble of a train, or of a cart over the stones of a road, are in their origin and relationship directly connected with the sonata and the symphony. The gradual process of this evolution is capable of being proved through every stage. H. G.

Continued from page 248.

BUSINESS AND COMMERCE:

Contributors:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).

COMMERCIAL TRAINING.—XII

EVERYONE who keeps a banking account should make a special point of taking every possible precaution to see that no cheque of his is ever either dishonoured by his bankers, or returned by them unpaid through any fault of his own.

Cheques are returned by bankers (1) Because there is insufficient money in the account to meet the cheque. (2) Because the amount written in words disagrees with the figures, such as " the sum of Ten pounds sixteen shillings and eightpence " and " £10 : 6 : 8." (3) Because the draft is misdated. (4) Because of an endorsement that is out of order.

Post-dated Cheques

Difficulty No. 1 can be overcome by keeping constantly in touch with one's Pass Book, and by knowing before drawing a cheque that there are definitely sufficient funds in the bank to meet it. Difficulty No. 2 can be solved by making a firm rule always to check the body of the draft with the figures most carefully, and Difficulty No. 3 would fall under the same ruling. Difficulty No. 4 is usually a matter for the payee, beyond the jurisdiction of the drawer. As a matter of fact, referring again to No. 2, legally and technically, the amount written in words is the amount to be paid.

In banking practice a Bearer cheque may be altered to become a cheque to Order without being initialled by the drawer so long as the full endorsement of the payee appears on the back. A cheque to Order altered into a Bearer cheque *must* bear the full signature of the drawer at the side of the alteration. Cheques from which small pieces have been inadverently torn are invariably cleared without comment, but a draft that had been torn in half and then gummed or pasted together would not be met.

No cheque is invalid because it is drawn on a Sunday, nor because it is undated. Sometimes in business it is necessary to give a post-dated cheque, that is, a draft bearing a date some little time ahead. This, however, should never be done except by arrangement with the payee, the object of post-dating a cheque being to convey to the payee the fact that on the date mentioned the cheque will be met, but there is an implication that prior to that date there will be insufficient funds if the draft be presented for payment. It is a business plan of waiting for the required funds to be paid in.

By the law of the land, the receipt of any sum of £2 and upwards necessitates the payment of one penny. Generally this penny is paid in the form of a postage and revenue stamp stuck upon the receipt and cancelled either by the date being written across it or part of the recipient's signature. In the ordinary way this receipt stamp is affixed to a separate receipt form and no stamp is required for the mere endorsement of the cheque. A few firms, however, in order to economise space and time in the handling of business documents print their receipt forms on the back of their cheques, and in such cases the signature of the recipient is both an acknowledgment of the receipt of the amount and also an endorsement of the cheque, and naturally when the amount is £2 or upwards the endorsement should be made over a penny stamp stuck on the back of the cheque in the space provided for the purpose.

Methods of Borrowing

Reference has already been made to the fact that not only are bankers custodians of money, but they are also prepared to lend funds to customers of approved standing. In business, of course, the borrowing of money enters far more into the everyday state of things than is the case in private affairs. As a matter of fact, bankers derive

a goodly proportion of their profit from the loans they grant; and it is very important in the commercial world to understand borrowing.

Reference has already been made to overdrawn accounts—that is to say, accounts from which the banker has paid out more than he has received. Overdrafts are quite common and frequent in banking practice, but accommodation of this kind should be arranged for in advance; and it is not advisable to issue a cheque for which there are not sufficient funds without acquainting the bank of the fact and requesting to be allowed the accommodation. As a matter of fact, the charges made for overdrafts to approved customers at a bank work out at only a fraction above the bank rate of the date on which the loan is sought, but it must be understood that an overdraft is purely a temporary measure and, if an advance of money is required for more than a very limited time, it will be necessary to arrange with the bank manager for a loan.

Charges for Interest

No special entry concerning an overdraft is made in the pass book beyond the fact that the charges for interest are entered in the usual way, but in the case of a loan the definite amount actually borrowed is entered in the pass book to the customer's credit, and, as it falls due, the interest is entered also. A loan is granted for a stated period in the majority of cases.

Loans from a bank are granted to customers, whose credit is in every way unimpeachable and with whom the bank has had long dealings, without the actual lodgment of securities. In the majority of cases, however, when a customer requires a loan to tide him over temporary financial difficulties, or to assist him in accepting an unusually large contract, he goes to the bank, interviews the manager, and arranges matters according to the particular circumstances of the case.

The granting or refusal of a loan rests entirely with the manager; but, as it is to the bank's profit to advance money to approved borrowers, it is seldom or never that a reliable customer is refused. Cash is loaned by banks on the bond of one or more securities—that is, people of standing, who sign documents that they accept full responsibility for the amounts so borrowed. Loans are also granted on title deeds to property, on Government Stock, Stock Exchange securities, whole life and endowment insurance policies.

Now, so long as the bank's interest is paid and the other requirements of the bargain faithfully kept by the borrower, the bank can only hold the security as such. If, however, the customer defaulted, the bank would possess the right to sell the securities, deduct what might be owing, and credit the account of the customer with the balance, if any, that might result. In the same way, the bank could surrender an insurance policy.

Another aspect of banking business is concerned with the discounting of bills or acceptances. This is a matter that applies particularly to commercial undertakings, in which the questions of ready money, of cash and of credit enter very freely at all times. A business man A, for example, buys from another business man B goods to the value of £100. A, however, is not prepared to pay in cash, nor to meet his liabilities, until three months have elapsed, by which time he will have realised upon a proportion of the goods. What A does, therefore, is, upon receipt of his invoice from B, and, having first made arrangements accordingly, to request B to draw on him a bill for £100 payable three months from the date of invoice. B then draws the bill and sends it to A for his signature and acceptance, and when making the acceptance A fills in the name of his bank and branch before returning the document to B.

Buying a Bill

B then takes the bill to his bankers and asks them to discount it for him; that is to say, place the sum of £100 to his credit, and to deduct interest at a rate slightly above Bank Rate for the period specified, i.e. in this instance three months. In other words, it may be said that the banker buys the bill for £100, less interest for three months. Three months later, in the normal course of events, B's bankers present the bill to A's bankers and receive the proceeds, though in the meantime A should have notified his bankers that the bill was nearing maturity and that it would have to be met on the day mentioned.

But supposing that in the meantime A finds that he is not able to meet the bill, and that when B's bankers present it on maturity there are insufficient funds to meet it, B will be charged with the full amount of the bill on his account, plus any incidental expenses that may have fallen to his bankers. It will then be for B to take such steps as may be necessary to recover the £100 from A, and such expenses as he may rightly charge.

A. B.

CHOOSING A CAREER.—XIII

Government Appointments for Women. In those departments where the supervision of women's labour is undertaken by the Government there are naturally many women employed, and among them are included **Women Factory Inspectors,** who are appointed after passing a limited competitive examination, and following nomination by the Secretary of State for Home Affairs.

Women who aspire to hold one of these positions should have received a university education, and eventually, after a period of probation, they will be required to understand the law as it applies to the various Acts of Parliament concerning factories and workshops. Their duties will take them into all kinds of places where women are employed, and in the prosecution of their work they may be called upon to undertake cases in courts of law; whilst it goes without saying that their characters should include tact, firmness, and a very marked insight into human nature.

Applications for nomination should be addressed to the *Private Secretary of the Secretary of State for Home Affairs, the Home Office, London, S.W.*1.

Under the jurisdiction of the Home Office there are also appointments for one **Lady Prison Inspector,** one **Prison Commissioner,** two **Inspectors of Reformatories,** and several women probationers for work at the Metropolitan Police Courts. This latter task concerns the supervision of delinquent children and young persons. In either of these appointments both training and influence are required to set the candidate upon the right road; but full information may be obtained by writing to the Home Secretary's Private Secretary.

The subject of school-teachers will be dealt with in a later chapter, but under the Board of Education there are **Women School Inspectorships.** For posts of this kind it is only natural that the candidate shall have obtained a good deal of personal experience in matters of education; to have taught at an elementary school is certainly a distinct asset; and this experience must be backed by a thorough knowledge of educational theories, and also by a degree at one of the universities.

Women Inspectors of Schools are appointed on the nomination of the President of the Board of Education at the time in office, and application may be made to him through his *Private Secretary, Board of Education, Whitehall, London, S.W.*1.

In connection with the work of the Board of Trade, there are several **Inspectors of Women's Industries,** and women are also employed in the execution of the departmental work of the Labour Exchanges, and various Advisory Committees. In the case of the **Labour Exchanges,** there are women officers, assistants, and clerks, whose duties embrace attending to applications from employers, interviewing applicants, card-indexing, and other clerical work of this large department. Some knowledge of industrial conditions and a university qualification is required by the applicant for a position in the higher branch of this service, and even for an ordinary clerical post some special industrial experience is desirable. A diploma of some kind in economics would be a very useful qualification to intending candidates. Application should be made to the *Private Secretary of the President of the Board of Trade, Whitehall, London, S.W.*1.

A considerable number of women are employed under the Ministry of Health. They include inspectors, assistant inspectors, and health officers charged with the duty of looking after the interests of women under the provisions of the National Health Insurance Acts. A university degree and a wide knowledge and experience of general health matters is insisted upon so far as the inspectors are concerned. Application should be directed to the *Private Secretary of the Minister of Health, Whitehall, London, S.W.*1.

Several **Lady Visitors** are employed in the office of the Public Trustee, whilst in the secretarial department there are occasional openings for skilled shorthand typists and clerks. Applications should be addressed to the *Secretary of the Public Trustee, Kingsway, London, W.C.*2.

Quite apart from the classes for girls and women in the Post Office (to be covered in detail in a later lesson), **Female Typists** are employed in practically all Government Offices. They rank as permanent civil servants, and are eligible, in accordance with the general rules, to pension or superannuation.

In every case every intending candidate must be nominated by the head of the particular office or department in which they wish to serve, and, as a general rule, where no particular influence can be brought to bear, a request for nomination may be addressed to the Private Secretary of the Minister or official governing the particular department chosen by the candidate.

In some instances candidates are nominated singly, in which event they are called

upon merely to pass a test examination. In other cases, where there are a number of girls or women under nomination, a competitive examination is held for all those who are waiting. Most patterns of typewriter are available for the test, so that no one may be given an unfair advantage.

Candidates must pass in the following subjects :—

1. Writing.
2. Spelling.
3. English composition.
4. Copying manuscript.
5. Arithmetic (first four rules, Simple and Compound, including English Weights and Measures, and Reduction).
6. Typewriting.

*7. Shorthand.

Then there is another class of lady clerks that finds employment in the offices of the Crown Agents for the Colonies, both in the Colonial Stock Department and in the Correspondence Branch. All the appointments are subject first of all to the nomination of the Crown Agents, and forms of application may be obtained by writing to the *Secretary of the Crown Agents to the Colonies*, 4 *Millbank, Westminster, S.W.*1.

Turning now to quite another type of female civil servants, we will describe the qualifications and duties of **Prison Wardresses.** Officially, they are described as the Female Subordinate Staff of the Prisons Service of England, and are employed at the prisons, Borstal institutions, and State Inebriate Reformatories.

For this service total abstainers are preferred, and among the qualifications required are exceptional moral character, sober and temperate habits. Physical strength and all that goes with good health and a sound constitution are expected, and preference is given to those candidates who have a personal knowledge of some industry or trade, for as part of the duty of a prison officer comes the giving of instruction to people under their care.

There is a qualifying examination in the elementary phases of reading, writing, and arithmetic, and on joining the service an officer is placed for the first four months under instruction at a prison where there is a training school. All officers are liable to be transferred from prison to prison.

The life of a prison wardress must necessarily be a confined one. That should be recognised at once. The monotony and greyness of the surroundings and of the work cannot be encouraging. Women with very cheerful temperaments are best suited to this kind of work.

Forms of application and the latest regulations may be obtained by writing to the *Prison Commissioners, Home Office, Whitehall, London, S.W.*1, the envelope to be marked in the lower left-hand corner "*Staff Branch.*"

For the service of the Prison Commissioners for Scotland the conditions vary slightly, and applications should be made in the applicant's own handwriting on a form to be obtained for the purpose from the *Prison Commissioners*, 11 *Rutland Square, Edinburgh.* When this form has been filled up it should be lodged personally if possible with the Governor of the Prison nearest to the applicant's residence, together with a recent photograph of the candidate.

So far as Ireland is concerned, application should be made to the *Staff Department, Prisons Board of Ireland, Dublin.*

We now come to a class of appointment that is not, strictly speaking, a Civil Service matter at all, though the women so employed are certainly as much public officials as those in any of the foregoing classes. The particular class in question is that embraced by the term **Women Sanitary Inspectors**, and it is a growing class, and one in which the majority of borough councils have an interest.

The appointments under discussion are entirely municipal, and are made by the various borough councils. The pages of the *Municipal Journal* should be watched for advertisements of vacancies for such workers, and applications made according to instructions there given.

In reality, women sanitary inspectors are the watch-dogs of the Medical Officer of Health for the locality to which they are appointed, and work entirely under his orders. The duties are very wide and cover an immense field, and the women themselves are given very full powers. The inspection of workshops, restaurant kitchens, and laundries with regard to ventilation, cleanliness, and a sufficient allowance of air space per person working there is just one aspect of the work.

Other duties include the inspection of offices where women and girls are employed ; the inspection of the homes of outworkers, where women toilers labour in their own rooms, with the idea of suppressing infection and uncleanliness ; and detection of unreported cases of contagious and notifiable diseases.

A. C. M.

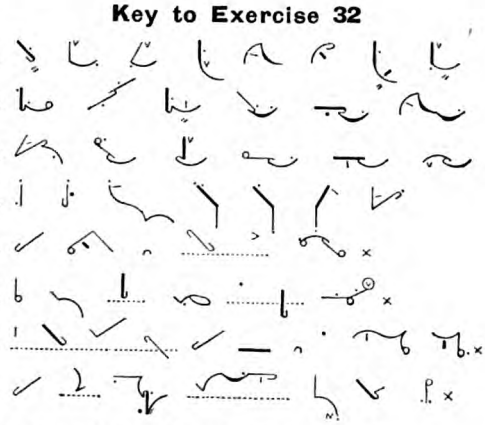
* The examination in Shorthand may be dispensed with at the request of the nominating Department.

SHORTHAND.—VIII

Key to Exercise 31

1. brawn, brawny, den, deny, grave, gravy, deaf, defy.
2. Spanish, planet, draughty, defence, fancy, referee, driven, pruning.
3. burner, turner, earner, examiner, leaner, Kitchener, venerable.
4. conclusive, conscious, conserve, contrivance, compulsory, committing, beating, hoeing.
5. *These* exercises *are on-the* rules *of Phonography.*
6. Tom travels *in-the southern* counties, *and-I in-the northern.*
7. *We-have often* stayed *at-the* Grosvenor Hotel.
8. *I-have-been within-the* library *to*-refer *to a* book *with-the* title "*The Belief in Heaven.*"

Key to Exercise 32



Alternative Forms for Fr, Fl, etc.—Besides the forms *fr*, *vr*, *thr*, *THr*, *fl*, *vl*, *thl*, *THl*, there are the alternatives *fr*, *vr*, *thr*, *THr*, *fl*, *vl*, *thl*, *THl*. The strokes) and (are not hooked for *r* or *l* because, thus hooked, they would be useless; hence, they serve a more useful purpose as alternative forms for *fr*, *fl*, etc.

The forms are known as the left curves because they are written to the left.

The forms are known as the right curves because they are written to the right.

Use of the Alternative Forms.—The alternative forms are used as follows—

(*a*) When Alone.—The left curve is written if a vowel precedes, the right curve if a vowel does not precede; thus—

aflow, *flow*; *fray*, *affray*; *flew*, *free*; *ether*, *three*; *throw*, *thrice*, *thrust*, *frost*; *flown*, *fluster*.

(*b*) When Joined.—The form is used which gives the better joining; thus—

frock, *flock*, *frame*, *flame*; *friar*, *flurry*, *flyer*; *fraud*, *fled*; *for which*, *flitch*, *France*, *flounce*, *flap*, *floor*, *flare*; *wafer*, *weaver*, *weather*, *heather*, *tether*, *leather*, *inflame*, *rivalry*; *Jeffrey*, *Dover*, *joyful*, *mouthful*.

Sh.—Upward *sh* is written before the right curves *fr*, *vr*; thus—

chauffeur, *shaver*.

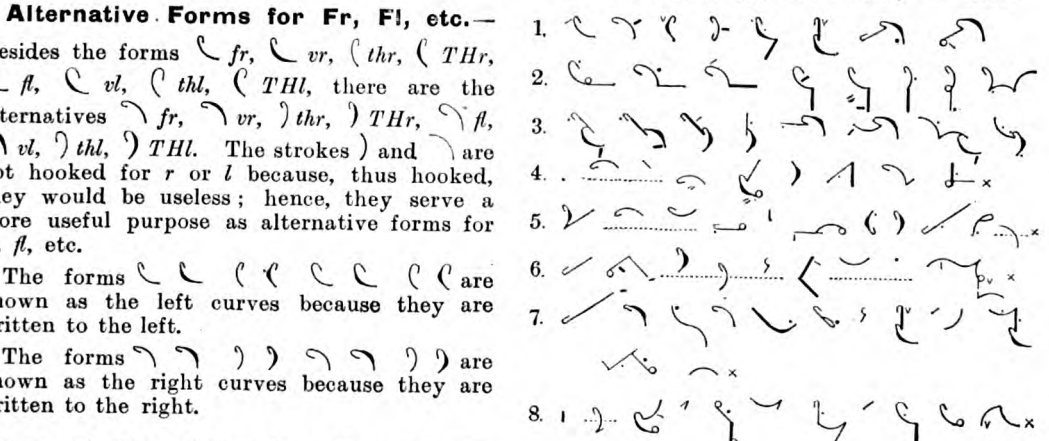
Downward *sh* is written before the left curves *fl*, *vl*; thus—

shuffle, *shovels*.

Exercise 33

Grammalogues.

from; *very*; *through*, *threw*; *they are*, *there*, *their*; *more*, *remark-ed*; *Mr.*, *mere*; *nor*, *in our*, *near*.

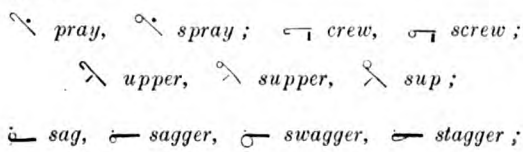


Key to Exercise 33

1. offer, fro, either, thrown, average, driver, weaver, hovel.
2. flask, flake, flog, flowed, Froude, thread, thirsty, thermal.
3. approval, approver, brother, tether, cavil, novel, removal, feathery.

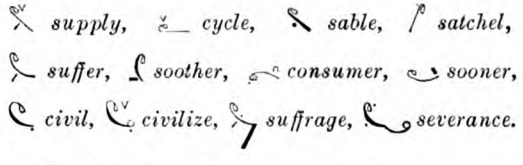
4. *The remark of Mr.* Chivers *was* read *from-the* desk.
5. *There-are more in-our* class *on* commerce than *there* were last *year.*
6. *We* hope *they-are through with-the* job *in a* month's-time.
7. *We-are very* far *from be*ing pleased *with-the* driver *and shall* endeavour *to*-replace *him.*
8. *He threw-the* shovels *and-the* spades *in-the* trenches *and* fled *for-his* life.

Circles and Loops to Initial Hooks.—The circles *s* and *sw* and the loop *st* are prefixed to the straight strokes hooked for *r*, by writing the circle or loop on the same side as the hook; thus—



pray, spray; crew, screw; upper, supper, sup; sag, sagger, swagger, stagger; switch, switcher, stitcher.

The circle *s* is written inside the hook in all cases except the straight strokes hooked for *r*; thus—

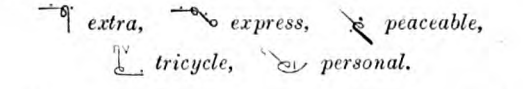


supply, cycle, sable, satchel, suffer, soother, consumer, sooner, civil, civilize, suffrage, severance.

The following should be noted—

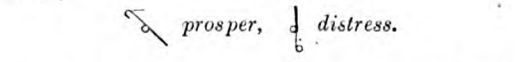
stifle, stable, swimmer, swivel.

When *spr, spl*, etc., occur medially, the hook *r* or *l* must be shown; thus—



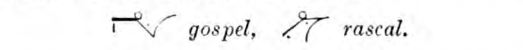
extra, express, peaceable, tricycle, personal.

When there is no angle between straight strokes, the hook *r*, however, need not be shown; thus—



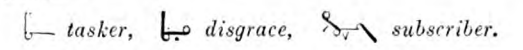
prosper, distress.

Stroke *r* or *l* must be written when the hook cannot be clearly shown; thus—



gospel, rascal.

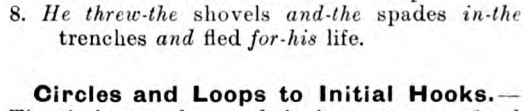
The following outlines should be carefully noted—



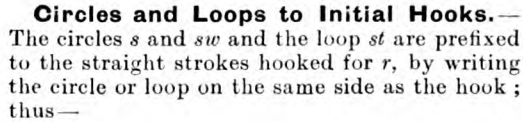
tasker, disgrace, subscriber.

In the last example the hook *r* is omitted, but does not interfere with the legibility of the outline.

Now give close attention to the following groups of words:—



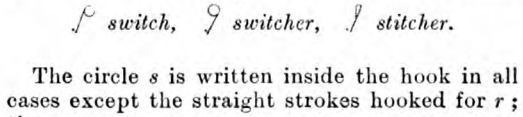
stay, state, tray, stray; eater.



sweet, sweeter; dusty, destroy;

gossips, express; disc, disagree;

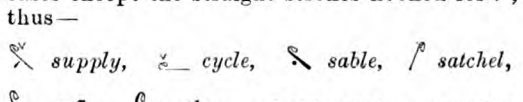
able, sable; busby, possible;



dusk, tricycle.

Exercise 34

GRAMMALOGUES



principal-le; liberty, member, remember-ed, number-ed; try, truth, true; Christian-ity, care.

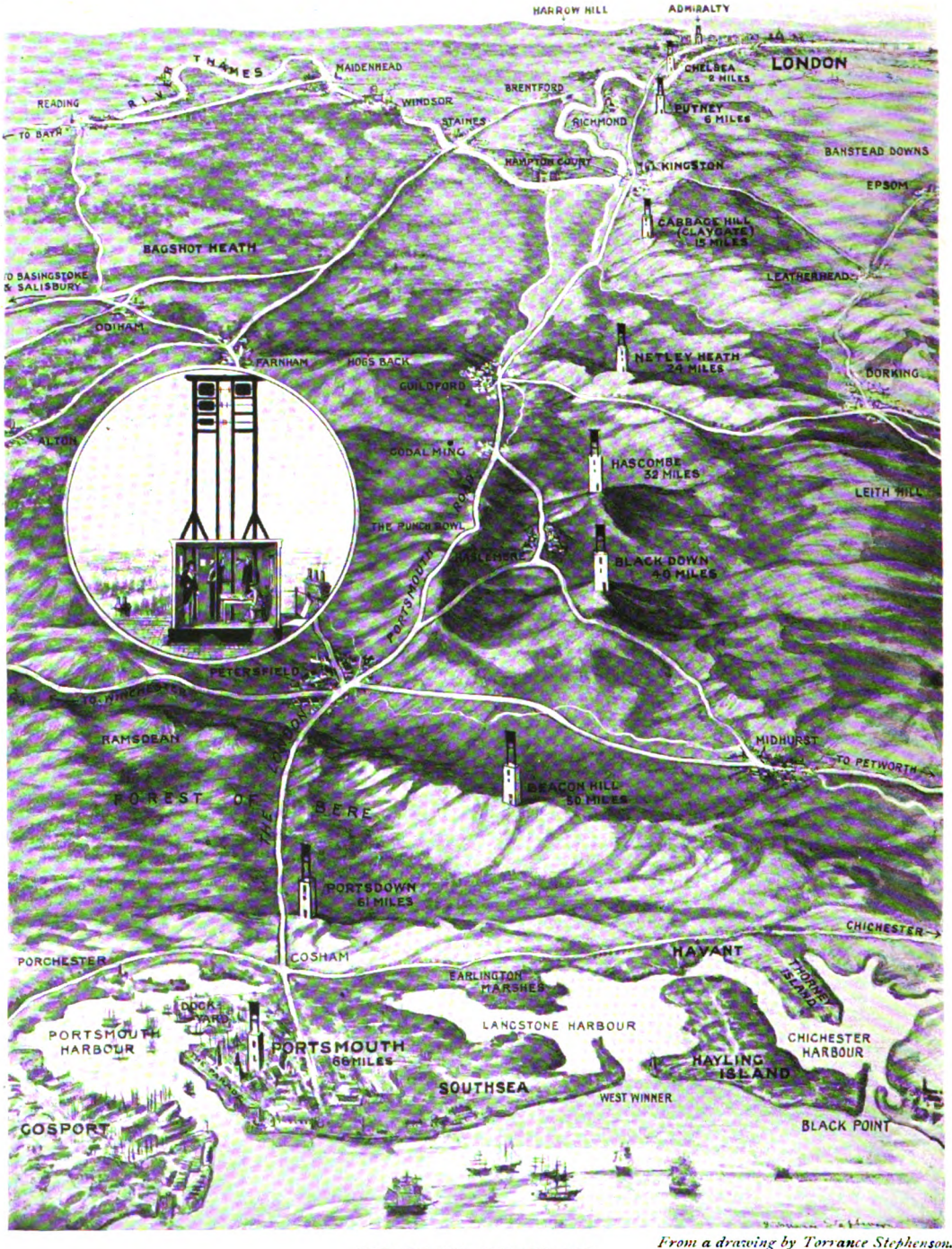
1.
2.
3.
4.
5.
6.
7.
8.

Exercise 35

GRAMMALOGUES

strength; surprise, surprised; chair, cheer; larger, journal; children; largely; sure; pleasure; initial-ly-led.

1. spray, sprays, strays, stream, stroll, set, setter, strap.
2. sweat, sweater, sweepers, sweeps, stutter, states, stops, stoppers.
3. settle, cipher, civilize, display, extras, steeples, supplies.
4. *The* size *of-the* Christmas-Tree *was a surprise to all-the children and-they* gave *a* loud *cheer.*
5. *I-have initialled the* invoice *for-the chairs.*
6. *The larger journal* gave *me pleasure in* reading *its initial* issue.
7. *We*-were *sure of-our* profits *largely owing to-the strength of-the* company.
8. *They*-were *surprised at-the* power *of-the* explosive.



From a drawing by Torrance Stephenson.

NELSON'S WIRELESS.

Before Signor Marconi's wonderful inventive genius made it possible for officials at Whitehall to communicate by means of wireless telegraphy with British warships on all the world's seas, the Admiralty was in communication with Portsmouth by means of a chain of visual stations, established in 1796. Inset is an interior of one of the stations. Fixed telescopes pointed at the adjacent signals.

Continued from page 255.

ENGLISH LANGUAGE AND LITERATURE:

***Contributors*:**—ENGLISH LANGUAGE (W. A. Craigie, M.A., LL.D.; E. W. Edmunds, M.A.). ENGLISH LITERATURE (John Derry, J.P.). PHILOSOPHY E. H. Tripp, Ph.D.). POLITICAL ECONOMY (J. W. Urwin). ETHICS (W. H. Koebel). PUBLIC SPEAKING (J. W. Urwin).

THE ENGLISH LANGUAGE.—VIII

PERHAPS the most effective type of paragraph is that which develops its theme on the cause and effect principle. This is especially valuable in scientific work or in argumentative compositions. It is nature's own method of satisfying the mind; and, properly used, it makes an unassailable appeal. But cause and effect must be clearly distinguished; facts must be appropriately marshalled, and inferences must be such as are warranted by the data we give. Otherwise, confusion of thought will result, and the paragraph will lose both its unity and its lucidity.

Précis and Summary

Example.—Study the following paragraph and criticise it from the points of view of unity, coherence and appropriateness:—

What a picture must the German Empire present to its infatuated rulers! Do they ever contemplate the appalling contrast between the present fact and the might-have-been? Industry and ability applied to all the arts of peace were leading them to a real "world-power"; they plunge their whole capital into the risks of war. An early victory, followed by crushing indemnities and abject submissions, dazzled their vision; they are now fighting for their very existence, and will be fortunate if they escape alive and whole. Their army was the pattern for Europe; it is now a dishonoured and defeated barbarity. German *Kultur* could once hold its head high among men; it is now, and will be ever, a thing of scorn and disgust, the badge of an unbridled savagery. Having decided on war, it was still open to them to bear themselves worthily, in chivalry, modesty and truth; but the epithet of Hun is disgraced by its association with the unprincipled cruelties, the callous lust, and the boastful lying, to which the scientific German has accustomed us. The world thought Fritz an industrious, honey-working bee: he is known now as a foul and destructive slug. But for the vanity of his rulers, he might have been—what he will never be again.

In a good paragraph we ought to find one main idea, and it ought to be possible to express this main idea in a single sentence or even by a phrase which might serve as a title or heading. Moreover, it ought to be possible to condense the subject-matter of a paragraph into, say, a quarter of its length. Such a condensation is known as a précis.

When the matter is tabulated without being cast into sentences, we have merely a summary. It is useful to practise both the précis and the summary.

As an example, we will take the passage given above:—

(*a*) *Title.*—The collapse of the German ideal.

(*b*) *Précis.*—The contrast between German hopes and the results of the war must be appalling to the rulers of Germany. In every sphere Germany stands lower than it stood before. Especially is the moral reputation of the German people shipwrecked, and the glamour of their army is tarnished by crime and by defeat.

(*c*) *Summary.*—Contrast between Germany as she is and as she might have been: illustrated by (i) their idea of world-power; (ii) their hopes of the war; (iii) their army; (iv) their Kultur; (v) their methods of war; (vi) the character of the individual German.

Punctuation

A system of stops is necessary, both from the point of view of the writer and from that of his readers. Rules can give no more than the general principles for the use of each stop. A stop should, in general, never be put except where the sense demands it.

The Full-stop (or period) is used to mark the end of a complete sentence. Its use denotes a clear and very distinct pause; and if it is replaced at the end of a simple

or complex sentence by a semicolon or other stop, we must always suppose that the following sentence is co-ordinated with the first, in sense or grammar, or both.

An abbreviation is indicated by the same mark as the period, but in this case we are not dealing with a stop properly so-called, and no pause has to be made. Nevertheless, the full-stop must not be omitted in any case of abbreviation, although custom allows the omission in the instances of Mr and Dr and one or two others.

Examples:—

Messrs. Jones; Rev. P. E. Thomas, M.A.; *e.g.*; *nem. con.*; Sept. 25.

The mark of interrogation is equivalent as a pause to the full-stop; it is to be used at the end of an interrogative sentence, but only when the question is a direct one.

Examples:—

What are you doing?—Direct Question.

He asked me what I was doing. — Indirect Question.

A direct statement may be given an interrogative turn by means of this mark.

Example:—

You can meet me, I suppose?—[Equivalent to a Question.]

We may also use it to throw doubt upon a particular word or statement.

Example:—

Someone has left him £50,000 (?).

Exclamation Marks

The mark of exclamation (!) also has the value of a full-stop, and should be used after an interjection or other expression indicative of strong emotion. It should not be employed unnecessarily; for example, in imperative sentences its frequent use to draw particular attention to a statement should be avoided, although it conveniently serves to give an ironical turn to a sentence.

Examples:—

(i) Away! Do not pause for a moment.

(ii) Alas! His friend is dead.

(iii) He has written the whole page without a mistake!

The first word in a sentence following a full-stop or its equivalent must commence with a capital letter. Capitals must also be used on the first word of a direct question or quotation, and at the beginning of each line of poetry.

Example:—

He said to me, "They are certainly coming to-day."

Capital letters must also be used—(*a*) for all proper nouns and adjectives derived from them; (*b*) for common nouns used as titles; (*c*) for all titles of distinction when they are used as parts of names; (*d*) for all common nouns which form important parts of the names or titles of places, books, etc.; (*e*) for all names referring to the Deity; (*f*) for the names of the days and months; (*g*) for the pronoun, *I*, and the interjection *Oh!*

Examples:—

(*a*) The German army was a powerful machine.

(*b*) I saw Captain Jones reading "Jack the Giant-Killer."

(*c*) The Duke of Wellington was a famous general.

(*d*) He lived in South Road, Wootton-on-the-Hill.

(*e*) He blamed the Almighty for his misfortunes.

(*f*) The merry month of May.

(*g*) Yet Ah! that Spring should vanish with the rose.

Uses of the Comma

The comma indicates a short pause, and is intended, more than any other stop, as a guide to the reader, to save him from breathlessness and to prevent confusion of thought. It is, however, a convenience, and not an absolute necessity. A passage ought to be perfectly intelligible without it, though the sense will not be so easily made out. Commas cannot convert a clumsy or ambiguous sentence into a smooth and lucid one. Thus, the comma does not redeem the syntactical impropriety of the following sentence:—

(i) My sister was riding her bicycle, wearing her best dress.

And in spite of rules to the contrary, the comma in (ii) is quite unnecessary:—

(ii) A pretty, little bird was singing outside.

While therefore we now point out the circumstances in which a comma is usually appropriate, it should not be used mechanically; where no pause is called for, no stop is to be written.

With this proviso, we may state the chief rules of the comma as follows:—

(*a*) It should be used to separate two close-connected members of a compound sentence, especially when they are linked by a conjunction. But when the two units have the same subject, the comma is generally unnecessary; and when the compound sentences are such that the components contain commas within themselves,

they should be separated by a semicolon. The semicolon is to be employed when the co-ordinate sentences are illative or strongly adversative.

Examples:—

(iii) The Army fought bravely, but the enemy were too strong to be defeated.

(iv) The General addressed his men and thanked them for their efforts.

(v) Whatever the result, the men are to be congratulated; and the country will not be slow in showing its appreciation.

(vi) They were outnumbered by five to one; yet they held their ground.

(*b*) In complex sentences, a comma should be used to mark off an adverbial clause, especially when it precedes the principal clause (vii); it is necessary also to mark off an adjective clause of the descriptive type, and is not to be omitted in any case when the relative pronoun is separated by other words from its antecedent. (viii) No comma is required to mark off adjective and adverbial clauses of the defining or restrictive type (ix, x), or in the case of noun clauses (xi).

Examples:—

(vii) As soon as he comes, I will let you know.

(viii) A gentleman in the train, who was evidently an authority, explained the matter to me.

(ix) I met the man who told me the story.

(x) They will come as soon as they can.

(xi) That his efforts have failed is no reflection upon him.

(*c*) Words, phrases or clauses which have been transposed are separated by a comma from the rest of the sentence.

Example:—

(xii) On account of his health, the Mayor resigned his office.

Parenthesis

(*d*) Words or phrases which form a parenthesis are marked off by commas, unless they form an interruption of the grammatical structure of the sentence, when dashes are to be used.

Example:—

(xiii) Twenty men, forming the remnant of a whole regiment, surrendered.

(*e*) Certain adverbs which are parenthetical in use also require commas; such are *however*, *accordingly*, *indeed*, and phrases like *in fact*, *as a matter of course*, etc.

Examples:—

(xiv) There were, no doubt, many other reasons for his going.

(xv) He was, perhaps, the most accomplished man of his time.

(*f*) Words forming a series and qualifying the same word are usually separated by commas; but the comma is not often necessary when a conjunction is used, nor is it necessary when one of the qualifying words partly qualifies another, as in Ex. (ii) above. Similarly commas should be used when words or phrases are grouped in pairs.

Examples:—

(xvi) He was sagacious, bold and successful in all his undertakings.

(xvii) Forward and backward, upward and downward, the vessel rocked dangerously.

Phrases in Apposition

(*g*) Words or phrases in apposition with another require commas, except in cases where the word or phrase forms an intimate portion of a name or title. So words used in an interjectional way, in address, should be separated by commas.

Examples:—

(xviii) Mr. Freeman, the mayor, presided.

(xix) William the Conqueror. King Henry of Navarre.

(xx) I urge you, gentlemen, to accede to this.

(*h*) A comma is to be used whenever a direct quotation is introduced.

Example:—

(xxi) It was Shakespeare who wrote, "Brevity is the soul of wit."

(*i*) The omission of a conjunction between two sentences is shown by a comma, thus:—

(xxii) John was industrious, his brother idle.

In most of the instances in which a comma may be used, the semicolon (;) may be employed whenever, for some special reason, a slightly more prolonged pause is required. Co-ordinate phrases or clauses are frequently separated by a semicolon, and must have that stop when there is a comma within them.

Examples:—

(i) Strong in mind and healthy in body; well-trained, and austerely self-disciplined, the late colonel was an invaluable officer.

(ii) If the Government prove equal to its task; if its members act with a single eye, we may face the future without qualm.

In these cases the semicolon is a lengthened comma; it may also be regarded as a shortened full-stop, which it may replace in co-ordinate sentences whenever the co-ordination is exceptionally close or whenever the co-ordinate parts are in sense subordinate, with the conjunction omitted.

Example:—

(iii) Friends are like icicles; they melt away as soon as the weather becomes objectionable to them.

The semicolon should be used before *namely, that is*, and similar words.

Example:—

(iv) Several new and rare gases have been discovered in the air; *viz.* argon, krypton, xenon and neon.

It is not always easy to decide when a semicolon is to be preferred to a comma or full-stop, and often it is a matter of indifference.

Use of the Colon

The colon (:) has a few limited uses, and should not be employed as an alternative to the semicolon or full-stop. In length of pause, it is roughly equivalent to the semicolon; but, rightly used, it suggests a particular relation between the sentences separated.

Its most appropriate use is between co-ordinate sentences, of which the second forms an explanation of or antithesis with the first.

Examples:—

(i) Many Americans were to be seen at the Savoy: it was Independence Day.

(ii) To err is human: to forgive, divine.

It is commonly found also, accompanied by a dash, preceding a list of details in expansion of a general statement.

Example:—

(iii) The following gentlemen were present among others:—Mr. Lloyd George, Earl Curzon, Mr. Balfour, Lord Derby and Sir Thomas Whittaker.

The dash (—) is used to indicate an omission, or a strong emotion, or an abrupt break in the consecutive development of the sentence.

Examples:—

(i) The man was Mr. J—— himself.

(ii) Be quick—run—take her away with you—she is not safe here!

(iii) Few men would believe that he—but I cannot proceed.

Double dashes are used often—and the use is unfortunately growing—in order to enclose a parenthetical sentence or phrase which breaks the grammatical or logical continuity of the main sentence. Brackets may also be employed for this purpose in certain cases.

Examples:—

(iv) They sat discussing politics for—you will be astonished to hear it—a matter of three hours.

(v) One member (Mr. Jones) refused to be convinced.

The dash indicates a prolonged pause of indefinite length, and is to be used, if at all, in addition to the other stops, if any, demanded by the sense. The use of dashes as alternatives for other stops is in general an indication of hasty and careless composition.

Quotation marks (" ") are used to enclose a direct statement or quotation which gives the writer's or speaker's exact words, but not otherwise. A quotation within a quotation is enclosed within single inverted commas.

Example:—

(i) He said, "The line 'Fools rush in where angels fear to tread' was written by Pope."

Titles of books, etc., are either enclosed by quotation marks or underlined in writing; in print they are usually given in italics.

A hyphen (-) is primarily used to indicate a break in a word, such as occurs when one part of the word is written on one line and the rest on the next. Such a break should always be syllabic, but many writers prefer to make it phonetic; *e.g.*, they would rather divide *preceding* into *prece-ding* than into *preced-ing*. This is a matter of taste and convenience, rather than of right and wrong.

The hyphen must be used also to join the parts of a compound word; *e.g.*, *sea-green, walking-stick, South-west, Attorney-General.* It is not always easy to decide when a word is a true compound or not. Many words which were originally compound have by usage become simple, and of course do not need a hyphen; *e.g.*, *bakehouse, wheelbarrow, carthorse, beehive.* Other words are treated as compounds illegitimately; *e.g.*, *humming-bird.*

The Apostrophe

A group of words which are for some special purpose treated as one must always be joined by hyphens, except when they are used in their normal way.

Examples:—

(i) Out-of-work miners cannot be found anywhere to-day.

but (ii) Many miners are out of work.

The omission of a vowel or other sound is indicated by an apostrophe (') ; as in *John's; don't, sha'n't.*

Two consecutive vowels generally blend into a diphthong; when it is desired to pronounce the two separately, a dicœresis (¨) is placed above the second; as in *naïve, aërial.*

E. W. E.

Continued from page 261.

HISTORY:

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THE ITALIAN REPUBLICS

THE Italian Republics—those little states destined for ever to be famous in the history of the arts, literature, and commerce—are among the most remarkable political phenomena of the Middle Ages.

From the establishment of the Roman Empire until comparatively recent times, republican institutions were, generally speaking, nowhere tolerated. Yet in Italy, the very centre of the civilised world, there sprang into being during the tenth century—when the one-will system of despotism was all but universal—states which were in every sense republican: states founded, in fact, on the principle of manhood suffrage.

This, at first sight, is apt to prove puzzling; though, as a matter of fact, the origin of these states is not very far to seek. Italy, throughout her history, had been subjected to many antagonistic influences, and in consequence was slower than other European countries to acquire for herself a distinct national character.

Small Armed Communities

In very early times, the overpowering predominance of Rome made it impossible for the inhabitants of the country to become a united people; whilst after the fall of the Western Empire all hope of unification was still further delayed. Italy was then parcelled out among barbarian chieftains; and later became subjected to the dictation of Constantinople in one part and of Germany in another.

At one time it seemed that the Gothic kingdom established by Theodoric (see Vol. I., page 266) might extend its sway over the whole peninsula. But this it failed to do; like the Lombard dominion which followed it, the rule of the Goths was swept away and destroyed before it could become thoroughly assimilated with the original population of the country.

The governance of Charlemagne, moreover, and his successors, was solely imperial. These monarchs had no thought for the welfare of Italy, or the development of the Italian people. Nor had the Popes, for, as we saw in the previous lesson, they aspired to a greater ambition—to the establishment of a spiritual despotism before which not only Italy, but the whole world, should bow.

Thus Italy, the unhappy victim of endless internal dissension and anarchy and of countless foreign invasions, found herself peopled by several different races, with no established form of central government, and no national language. In these circumstances, the inhabitants of the country had no alternative other than to form themselves—if only for purely defensive purposes—into a number of small armed communities.

The Eternal City

Now republican Rome was the pattern on which these little states were moulded. When the seat of government of the Roman Empire was transferred to Constantinople, the Romans, left to their own devices, had to improvise a ruling system, and find some means of resisting the many enemies who threatened their safety, and who did, in fact, again and again come down in force and offer violence to their city.

Accordingly they turned back to an old page in their history, and, deeming that the early days of the city were those of her greatest strength and glory, fashioned the new government after the model of the old. Thus Rome, who had already introduced into Western Europe democratic government, despotism, and imperialism, again became the cradle of republican institutions.

But the Romans were neither sufficiently strong nor sufficiently united to establish themselves permanently on this basis. In course of time their bishops, whom they invited to share in the government, contrived to assume semi-royal prerogatives, and so subverted republicanism, though they cleverly retained its form. It is improbable,

however, if, in any circumstances, Rome would have been able to retain her liberties. The Frankish and German Emperors were too much interested in possessing her, and in winning that prestige which possession of her alone could give, to allow the Eternal City to remain long in the peaceful enjoyment of independence. Still, Rome set an example

Photo: D. McLeish.

THE ONLY HORSES VENICE EVER KNEW.

The famous bronze horses over the principal portal of St. Mark's. They once adorned the triumphal arch of Nero and were taken to Constantinople before they found their way to Venice. Napoleon carried them to Paris in 1797.

in independent government which other cities in Italy—particularly in Lombardy—were not slow to follow.

It is impossible to trace precisely the course of the movement. Republican forms of government, however, were undoubtedly in actual existence in several of the cities of Northern Italy before the end of the tenth century. The first important city, if not the earliest thus to make itself independent, was Milan, which for many years withstood imperial oppression, and maintained itself—as in the year 991, when it expelled its archbishop—against priestly interference.

Now Milan, as the centre of Lombardy and the old seat of government of the Lombard kings, was—on account of its situation and prestige—in a stronger position than the other cities. When, therefore, the question arose of cities banding together to resist the demands of King, Emperor, or Pope, Milan naturally was looked to as leader in the struggle, and, as naturally, accepted the post.

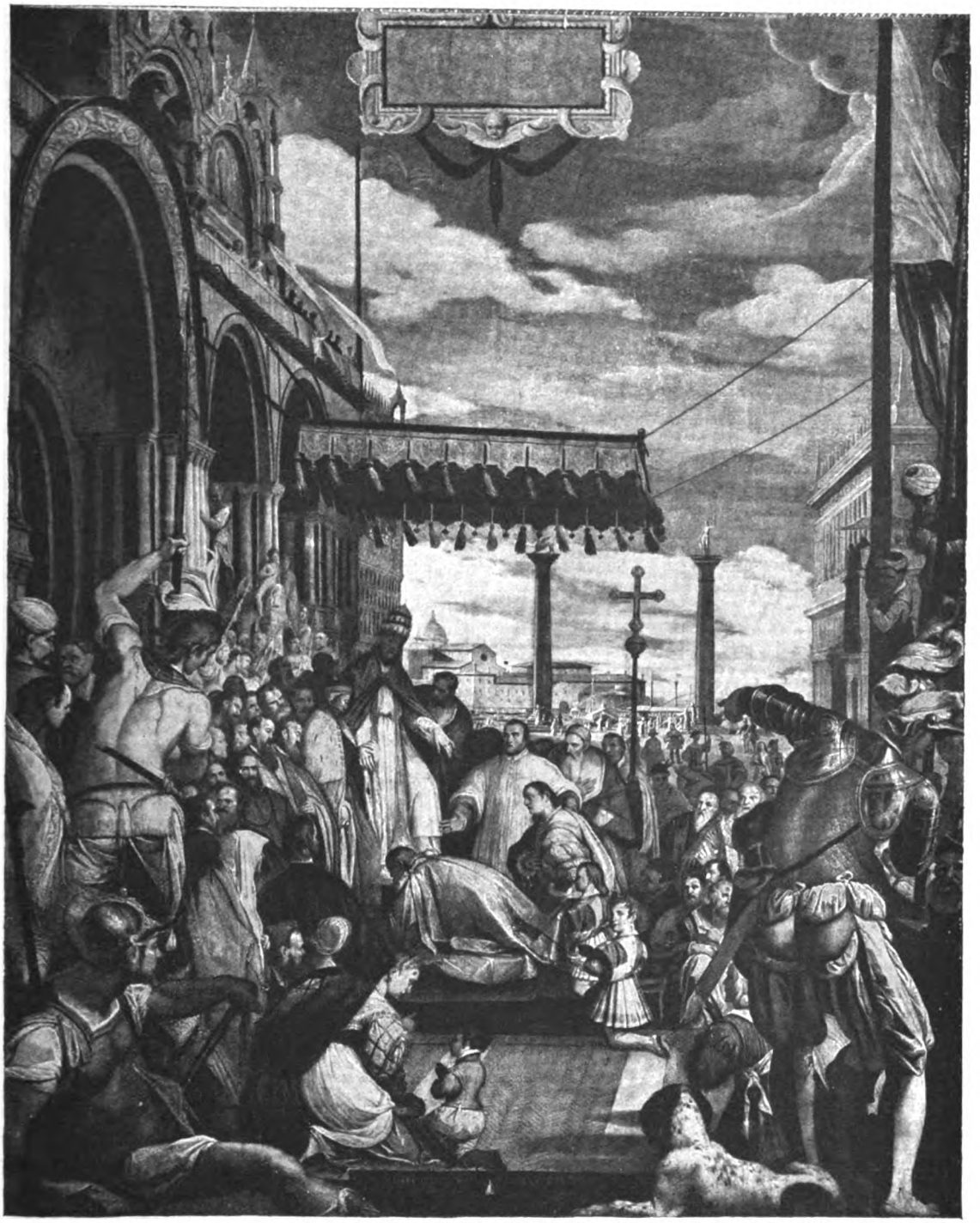
It was Milan that, in the year 1167, organised the League of Lombardy against the Emperor Frederick Barbarossa. It was Milan, moreover, that, after suffering terribly from his attacks, finally defeated him at the Battle of Legnano, and so secured the Peace of Constance (1183).

Emperor *v.* Pope

By the terms of this treaty, which was concluded under the auspices of Pope Alexander III., the towns that had joined the League were accorded, save for a purely formal acknowledgment of the Emperor's overlordship, an absolute independence. The right of levying war, of raising fortifications, and of administering justice were specially conferred, together with the right to elect magistrates. Frederick, further, was forced to recognise a Pope whom he had repeatedly sworn he would never obey. For once, in fact, the Pope and the towns of Lombardy had made common cause, and, under Milan's leadership, had gained a common victory.

Had only the Lombard cities then realised that their interests were identical, they might have been able to agree upon a common policy, and have formed themselves into a federal union which would have been strong enough to defy all external interference. Unfortunately, however, they allowed themselves to become ensnared in the political ramifications of Popes and Emperors, and the rivalries and jealousies which resulted therefrom proved their ruin.

The Peace of Constance, in fact, marks the real beginning of the long duel between the Emperors and Popes for the possession of Italy: the struggle, as it is known, between the Guelfs and Ghibelines. The word Guelf, which, at about this time, came to be applied to the anti-imperial party in Italy, is an Italianised form of Welf, the family name of the Hohenstaufen Emperors' most bitter enemies in Germany; whilst the Ghibeline party—the word Ghibeline being probably a



From the painting by Zuccari, in the Ducal Palace, Venice: by permission of D. Anderson.

FREDERICK BARBAROSSA (1152–1190) PAYING HOMAGE TO POPE ALEXANDER III.

Totally defeated at Legnano in 1183 by the army of the League of Lombardy, the Emperor was forced to sue for peace with his rebellious Italian subjects, to grant independence to the towns which had joined the League, and himself to pay homage to a Pope whom he had sworn never to acknowledge.

Mediæval Italy, peopled by several different races, with no established form of central government, and no national language, was forced—as a purely defensive measure—to take the form of a number of small armed communities.

corruption of Waibling, the site of one of the imperial castles—was composed of the Emperor's adherents, and, therefore representative of anti-papal feeling in Italy.

In addition to Milan, the more important of the Italian republics were Genoa, Florence, Pisa, Cremona, Pavia, Parma, Verona, Padua, Bologna, Ferrara, and Faenza. Later, Venice—more famous than all the rest—rose to power.

One system of government seems, with slight modification, to have been general to all the earlier republics. The people elected one or more consuls to preside over the Council of Safety—a ministerial committee which was chosen by the people, and charged with the actual work of government.

The abuse of power by these rulers led, in the twelfth century, to the institution of what are called *podestas*—i.e. governors selected from some family of known eminence in Italy.

The *podesta*, who acted as commander of the army, and as the source of law and justice, was rarely a native of the city. Petty jealousies—the citizens found—rendered it inadvisable for one of their own number to be appointed. Besides, they preferred that the *podesta* should be a foreigner, since a foreigner, they maintained, was less likely to show favouritism. The danger of tyranny they lessened by making the office elective, and tenable for one year only. But, despite such precautions, it is evident that the office conferred powers that could be easily abused, and that only men of character and integrity could properly discharge its duties.

In actual fact, there grew out of the institution of *podestas* those oppressive dominations by powerful families which brought about the downfall of the republics.

War was the one sure heritage of these little states. As time went on, therefore, men who had distinguished themselves in war came almost exclusively to be chosen for *podestas*—the commanders of foreign mercenary armies, and others, who had made war a trade, and were willing to sell their services to the highest bidder. Once elected to fill an office that was both civil and military, these men naturally subordinated the civil to the military; and proceeded, in fact, to establish a despotism which no civilian power could withstand.

Coups d'état followed, resulting in the recognition of hereditary tyrannies which soon stamped out the last traces of the spirit of freedom that had led to the foundation of the republics.

From the picture by Sir John Gilbert, R.A.

A VENETIAN COUNCIL OF WAR.

One system of government was common to the early Italian republics: the people elected one or more consuls to preside over a Council of Safety, an elected committee charged with the actual work of government.

It was in this way that the house of Sforza came to rule for years in Milan. In some cities, moreover, tyrannies of this sort were founded by native citizens. The Medici of Florence may be quoted as an example; also the Doria of Genoa, and the Malatesti of Rimini.

Under these conditions, popular government was, of course, impossible; and gradually the people again passed under the yoke from which their forefathers had

battled to escape. But during this new subjugation they had at least one satisfaction—the tyrant was one of themselves, and, therefore, within reach.

All these republics had certain territorial possessions, just as had the city-states of ancient Greece; whilst in some cases they also exercised their sway over dependent cities. The lot of these latter often was very hard, tribute, and contributions of men and material for war, being ruthlessly exacted from them. In consequence, they were apt sometimes to prove a source of weakness, rather than of strength; though usually fear of the punishment that would be meted out to them after the war was over served as a deterring influence, and kept them loyal.

Florence Under the Medici

Florence, prior to the rise to power of the Medici family in the fifteenth century, was, so far as political institutions are concerned, more purely republican than any of the other Italian commonwealths; whilst few states, if any, have contributed so many names to the world's list of illustrious men as has the home of Dante and Michael Angelo. Her commercial activities were second only to those of Venice. They were Florentine financiers, moreover, who introduced into Europe the system of banking; and, as the great money market of the mediæval world, Florence held a position of unique importance.

Even after the rise of the Medici, she retained at any rate the form of republican institutions; and, just as Venice has been aptly described as the Sparta of mediæval Italy, so Florence may be called the Athens. The Medici, in fact, though despots, were, on the whole, wise, beneficent rulers, as indeed befitted the fathers of the Renaissance; the great patrons of Italian art and learning.

Florence remained a republic until the middle of the sixteenth century, when Cosmo di Medici, having added the commonwealth of Sienna to her territories, persuaded the Pope and Emperor to confer on him a dukedom, and assumed the title, the Grand Duke of Tuscany.

Unhappily for their own welfare and stability, the Italian republics, like their Græcian prototypes, maintained an almost continuous state of war among themselves. These wars sometimes were very costly and very bitter. A notable instance was the long struggle between Genoa and Venice, which ended in the fourteenth century with the ruin of the former state.

Venice arose in the fifth century during Attila's invasion of Italy, when many of the inhabitants of the country fled for safety from the terrible Hun to the islands of the Lagune at the mouth of the Brenta. The small commonwealth thus created pursued an obscure course for several centuries; but its trade steadily increased, and by the eleventh century it had come to be recognised in Europe as a great maritime power.

In very early times, the administration was divided between Tribunes, but towards the end of the seventh century it was determined, owing to internal dissension, to put the supreme power in the hands of one man, distinguished by the title of Doge, or Duke. This office was thenceforth preserved almost without intermission throughout the history of the state, though the government gradually became a narrow oligarchy.

By virtue of her unique situation, Venice secured practically a monopoly of the trade between Europe and the East; and her wealth and strength increased to such an extent that she roused against herself the bitter hate of less fortunate neighbours.

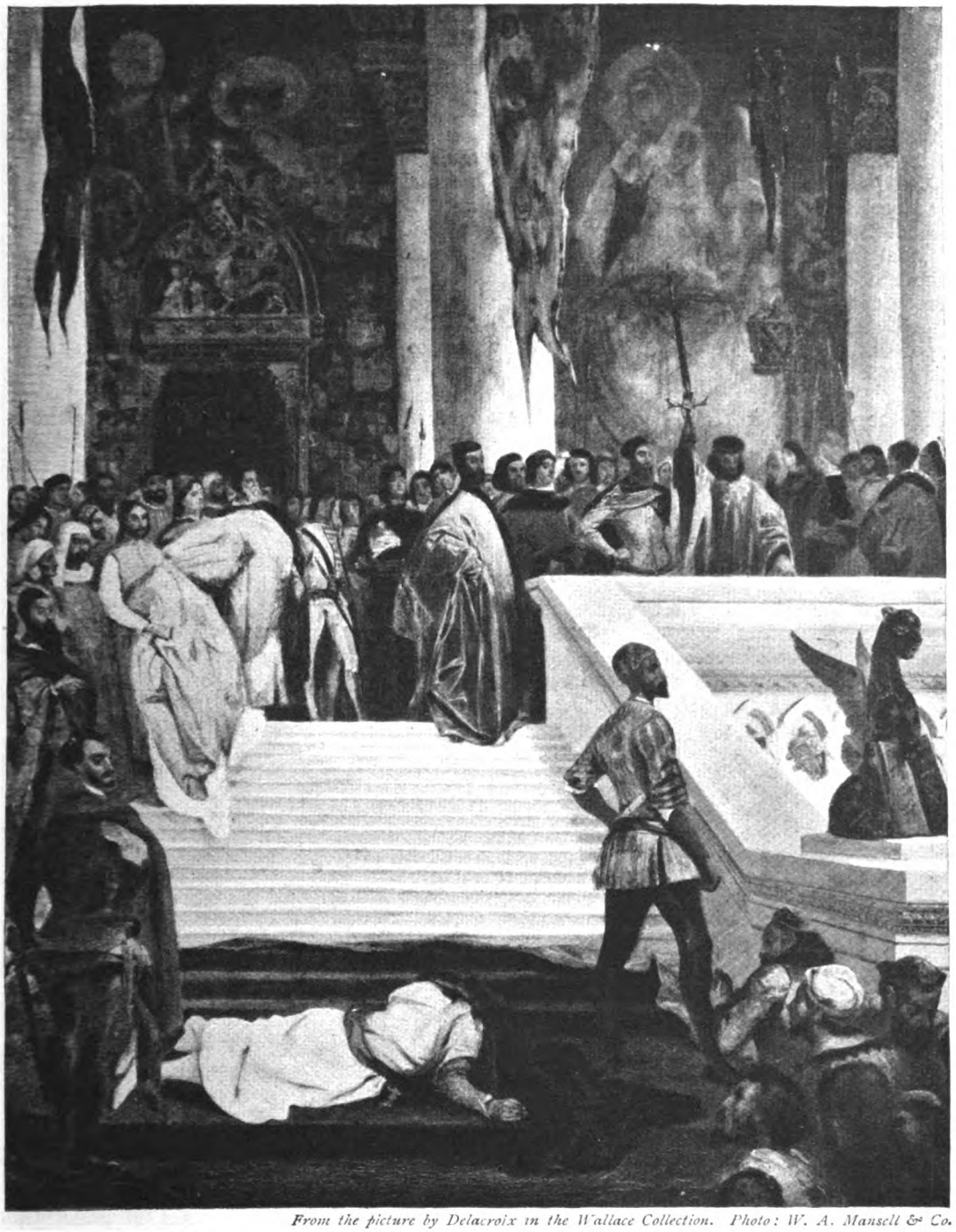
In 1378 Genoa, Padua, and Hungary formed a league against her, and assailed her with their united forces. For a while, things went well for the allies: and the Genoese admiral, Doria, having succeeded in effecting a blockade of the city, at length forced the Venetians to sue for peace.

The Republic of Venice

But Genoa refused to grant terms; and the Venetian ambassadors, who had been sent to treat, returned with the assurance that there should be no peace until a curb had been put "in the mouths of those wild horses that stand upon the place of St. Mark."

Made desperate by this retort, the Venetians boldly attacked the enemy. So well did they fight, moreover, that despite its immense superiority, they utterly destroyed the blockading fleet. From this time, Genoa steadily declined in power. Venice, however, continued to expand; and, although for a while she was forced to make concessions to the King of Hungary and the Lord of Padua, she was able before long to reduce the latter to a condition of dependency, and to cause the former to beg for alliance.

Long after all the other republics had been overthrown or absorbed, Venice remained, for wealth and influence, one of the most important states of Europe. And even after she had been shorn of much of her splendour, and stripped of her mainland territory, even



From the picture by Delacroix in the Wallace Collection. Photo: W. A. Mansell & Co.

THE EXECUTION OF THE DOGE, MARINO FALIERO.

An incident in fourteenth century Venetian history which Lord Byron has immortalized. The Doge, furious at what he considered the inadequate punishment imposed upon a man who had insulted him, entered into a conspiracy to overthrow the republic. But he was betrayed and executed on the Giant's Stairway—where Doges were wont to take the oath of fidelity.

after she had ceased to be the *entrepôt* between Europe and the East, she continued to elect her Doge, and to preserve at any rate the shadow of independence until at last Napoleon executed the threat of the Genoese and put a bridle in the mouths of the horses of St. Mark.

In 1797 the Republic of Venice ceased to exist. In 1814 it was embodied by treaty in the Austrian Empire. Venice remained in subjection to Austria—a subjection which she bitterly resented—till 1866, when she became part and parcel of the present Kingdom of Italy, in accordance with the terms of the peace concluded between Prussia and Austria after the latter's crushing defeat at Sadowa.

Garibaldi and Cavour

The remainder of Italy had thrown off the foreign yoke in 1859, as a result of the victories which Victor Emmanuel, King of Sardinia, and his great minister, Cavour, aided by the Emperor Napoleon III., gained over the Austrians at Magenta and Solferino. Venice, too, might then have won her freedom had not the French Emperor become alarmed at the extent of Victor Emmanuel's successes, which the national enthusiasm aroused by Garibaldi and his volunteers had made possible. Fearing the prospect of a united Italy, he insisted on the conclusion of a peace.

By the terms of this treaty, Venice was still left in Austrian hands, and Piedmont —which formed the bulk of the Sardinian kingdom, increased only by the incorporation of Lombardy, and the duchies of Parma and Modena. But in 1860 Tuscany and Sicily also joined Piedmont. Victor Emmanuel was then proclaimed King of Italy; and, by the addition of Venice to his kingdom in 1866, brought the whole peninsula under his rule—Rome only excluded.

United Italy

That the Pope should be deprived of the last of his temporal possessions was a proposal which Napoleon III.—if only out of deference to Catholic sentiment in France—could not bring himself to countenance. Rome, therefore, maintained her independence till 1870, when the French Emperor, grappling vainly with the Prussians for his throne, found himself no longer in a position to protect her; and Victor Emmanuel entered the city without opposition. Thus the Italians at last became a united nation, with Rome, the Eternal City, as their capital; and, though the Pope was guaranteed the rank and privileges of a sovereign prince, the Papacy ceased to be a temporal power. J. A. B.

After the painting by C. Ademollo in the Art Gallery of Capodimonte, Naples.

THE MEETING OF GARIBALDI AND VICTOR EMMANUEL

near Teano where, the success of the Great Campaign of 1860 being assured, Garibaldi laid down his dictatorship and hailed the Sardinian Prince as King of a free and united Italy.

Continued from page 279.

SCIENCES:

Contributors:—ANTHROPOLOGY AND ETHNOLOGY (Sir H. H. Johnston, G.C.M.G., K.C.B.). ASTRONOMY (Arthur R. Hinks, M.A., F.R.S.). BOTANY (E. W. Edmunds, M.A., B.Sc.[Lond.]). CHEMISTRY (E. H. Tripp, Ph.D.). ELECTRICITY AND MAGNETISM (L. M. Parsons, M.Sc., D.I.C., F.G.S.). GEOLOGY AND MINERALOGY (Arthur Holmes, D.Sc. [Lond.], A.R.C.S., D.I.C., F.G.S.). PHYSIOLOGY (Sir Malcolm Morris, K.C.V.O., and D. W. Carmalt-Jones, M.A., M.D.[Oxon.]). SOUND, LIGHT, AND HEAT (E. W. Edmunds, M.A., B.Sc. [Lond.]). ZOOLOGY (E. A. Bryant and Ashley G. Brown, F.Z.S.).

CHEMISTRY.—XIV

Diffusion and the Gas Laws.—The phenomena of gaseous diffusion, or the property of gases to mix in all proportions, become much more intelligible when viewed in the light of the molecular theory. If some musk be introduced into a room free from air-currents, its perfume will soon be perceptible many yards away. As the sensation of smell is due to the impact of very tiny particles upon the nerves of the nose, it follows that the musk particles must penetrate the air.

The manner of this penetration is more easily conceivable if we admit the air to be composed of moving molecules than if we imagine it to be a continuous mass, without intervening spaces for the musk particles to get through.

Experiment XLVI.—*To illustrate the diffusion of gases.*

An inverted beaker is suspended from the arm of a balance and exactly counterpoised. (Fig. 21.) The air in it is displaced by hydrogen, and the beaker rises. If now the balance be kept away from air-currents, it will be observed that the beaker very gradually descends, and ultimately the original equilibrium is restored. Now hydrogen is over 14 times lighter than air, and gravitation would tend to keep it in the beaker and the air below it. If both hydrogen and air consist of particles with a motion of their own, a gradual interchange will take place between them, so that in time there is practically no hydrogen left in the beaker. This gradual intermingling of gases, quite apart from any effect due to gravitation, has no light cast on it by the continuous theory of the structure of matter.

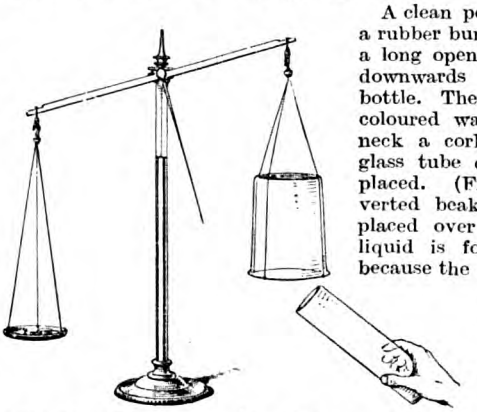


Fig. 21.—To explain the diffusion of gases.

The astonishing uniformity in the composition of the gaseous mixture, air, is a consequence of this same property of gases to diffuse and mix completely. Were this property non-existent, the water-vapour would be found in the topmost layer of the atmosphere, followed by successive layers of nitrogen and oxygen, whilst the heavy carbon-dioxide would accumulate on the ground and asphyxiate all men and animals. Thomas Graham, a well-known Scotch chemist, made many discoveries on diffusion, and it was he who found that a light gas diffused more quickly than a heavy one.

Experiment XLVII.—*To show which diffuses the more quickly—a light or a heavy gas.*

A clean porous cell is fitted with a rubber bung through which passes a long open tube dipping vertically downwards into a two-necked bottle. The bottle contains some coloured water, and in its second neck a cork, traversed by a bent glass tube drawn out to a jet, is placed. (Fig. 22.) When an inverted beaker full of hydrogen is placed over the cell, a stream of liquid is forced out at the jet, because the light hydrogen diffuses more quickly into the cell than the heavy air in the cell can diffuse out, thus causing an increase in gaseous pressure inside the apparatus.

When the beaker is removed, the fountain-display is arrested, and the liquid moves in the opposite direction, up into the vertical tube. In this case the lighter gas within the cell diffuses outwards faster than the surrounding air penetrates inwards, thus causing a reduction of pressure inside.

The experiment may then be performed with carbon dioxide instead of hydrogen, only in this case the long tube must have a double rectangular bend so that the cell may be immersed in an upright beaker containing the heavy oxide of carbon. The observations will be similar to those recorded above, but they will take place in the reverse order.

The exact relation between the rate of diffusion

of a gas and its density is given in *Graham's Law.* "*The rates of diffusion of gases are inversely proportional to the square roots of their densities.*"

If γ_1, γ_2, be the rates of diffusion of any two gases, and α_1, α_2, their respective densities, $\gamma_1 : \gamma_2 = \sqrt{\alpha_2} : \sqrt{\alpha_1}$. If the gases be hydrogen and oxygen, $\gamma_h : \gamma_o = \sqrt{16} : \sqrt{1} = 4 : 1$. Thus hydrogen diffuses four times as rapidly as oxygen. In fact, as hydrogen is the lightest of all gases, its rate of diffusion is the greatest. On this account a slight leak in a hydrogen apparatus is more serious than in any other.

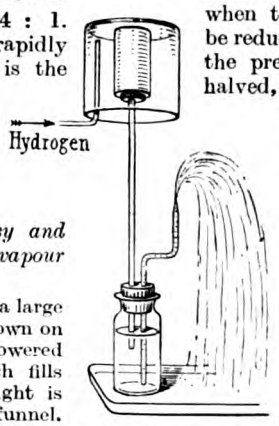


Fig. 22.—To show that hydrogen diffuses more quickly than air.

Experiment XLVIII.—*An easy and interesting experiment is to make ether vapour diffuse through a soap film.*

A few c.cm. of ether are poured into a large beaker. (Fig. 23.) A soap bubble is blown on the end of a short thistle-funnel and lowered vertically into the ether vapour which fills the beaker. After a few seconds a light is applied to the upper open end of the funnel. The blue flame observed is that of ether, which has penetrated through the film of soap.

The phenomenon of diffusion is not confined to gases; it takes place, although very much more slowly, between liquids which mix with one another, and even solid diffusion has been proved.

Experiment XLIX.—*To show the diffusion of liquids.*

A tall gas cylinder is nearly filled with water, and then a strong solution of copper sulphate is poured through a long tube or funnel to the bottom. The tube or funnel must be closed at the top before it is withdrawn, otherwise the sulphate solution remaining in it will fall into the water and colour it. The jar should be closed at the top and then set aside in a place where it will not be disturbed. The heavy copper sulphate solution will rise very slowly and ultimately mix completely with the water. (Fig. 24.)

The diffusion of solids has been confirmed by keeping small cylindrical pieces of pure lead and pure gold clamped together under great pressure. After many years, gold was found in the lead cylinder and lead in the gold.

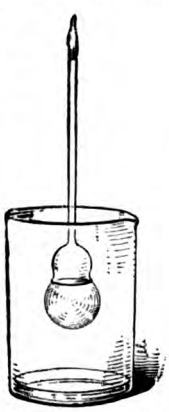


Fig. 23. — The diffusion of ether vapour through a soap film.

The Gas Laws. — The study of the physical behaviour of gases belongs to the science of Physics, but the chemist has to manipulate, measure, and analyse them so frequently that he must needs know the laws which govern their behaviour, and how they can be applied to the special problems of Chemistry. The two most important of these laws are those which refer to the influence of changes of pressure and changes of temperature upon the volumes of gases.

The connection between the volume and the pressure of a gas is given by *Boyle's Law*, which states that "*the volume of a given mass of gas varies inversely as its pressure, when the temperature is constant.*"

Thus if a quantity of oxygen measures 1 litre at a certain pressure, it will occupy 2 litres when that pressure is halved, and 3 litres if it be reduced to one-third; and conversely if the pressure be doubled, the volume will be halved, and so on. To avoid unnecessary labour, whenever possible the chemist measures the volume of a gas when its pressure is equal to that of the external air, because the latter is easily found by reading the height of the barometer. In order to make all his measurements comparable, he then calculates what the volume would be at the so-called normal pressure of 760 mm. of mercury; and to do this he has to apply Boyle's Law.

The volume of a given mass of hydrogen is 185 c.c., when the pressure is 750 mm. What will be the volume under normal pressure? Since the volume varies inversely as the pressure, when the latter is raised from 750 to 760 mm., the former will be proportionately diminished. If the new volume be x, $185 : x = 760 : 750$, $\therefore 760x = 750 \times 185$ or $x = 182{\cdot}6$ c.c.

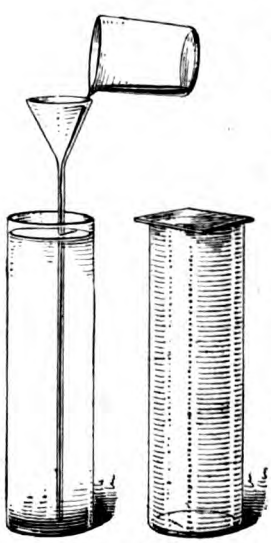


Fig. 24.—To illustrate the diffusion of liquids.

This arithmetical, or algebraic, operation of deducing the volume at normal pressure is called "correcting" for pressure, and the quotient of $\frac{750}{760}$ is called the *correction factor.* If the original pressure had been 770 mm., the volume under 760 mm. would be given by the ratio: $185 : x = 760 : 770$, from which $x = 187{\cdot}4$ c.c.

It sometimes happens that it is not possible, or convenient, to measure the volume at atmospheric pressure. In this case the calculation is a little more intricate.

If 20 c.c. of a gas are confined in a graduated tube over mercury, so that the level of the latter in the tube is above that of the liquid in the surrounding vessel, the volume under atmospheric pressure may be directly read by lowering the tube until the levels are the same. In this case the pressure of the enclosed gas exactly counterbalances the pressure of the air on the surface of the liquid in the cylinder, and if the latter be taken as 750 mm., the pressure of the gas is also 750 mm. Supposing, however, it is impossible to lower the tube, the gaseous pressure can be calculated and from it the volume at 760 mm. can

be found. The height of the mercury level in the tube above that in the cylinder = 300 mm. The external air-pressure is now balanced by the sum of the gaseous pressure and the weight of the column of mercury.

Therefore the pressure of the gas = pressure of the air—pressure of 300 mm. of mercury, = 750 − 300 mm. = 450 mm.

20 c.c. of gas at 450 mm. pressure would become at 760 mm.: $20 \times \frac{450}{760} = 11.8$ c.c.

If the gas be confined over water, the height of the water in the tube above the level of the water in the cylinder must be divided by 13·5 (the density of mercury) in order to obtain the height of an equivalent column of that liquid.

The relation between the volume of a gas and the temperature is the purport of *Charles's Law*. "*Equal volumes of all gases under the same pressure expand to an equal extent for every degree rise in temperature.*"

The expansion is approximately $\frac{1}{273}$ of the volume at 0° C., and this fraction is called the *coefficient of expansion*. The converse also holds good: if a gas be cooled, its volume diminishes by $\frac{1}{273}$ of its volume at 0° C. for every degree fall in temperature. If we have 273 c.c. of a gas at 0° C., its volume at − 1° C. will be 272 c.c., at − 10° C. it will be 263 c.c., and so on, so that at − 273° C. the volume will be zero.

This temperature, − 273° C, is called *absolute zero*, and it has never been attained, for all the known gases liquefy before it is reached. For the measurement of gases, a scale of temperature called the *absolute scale* has been adopted, in which each degree is of the same magnitude as a degree Centigrade, and 0° Absolute (0° A.) corresponds to − 273° C. It is not difficult to see that a temperature given in degrees Centigrade can be converted into degrees Absolute by adding 273.

A litre of gas at 0° C. will become $1 + \frac{20}{273} = \frac{293}{273}$ at 20° C.

The volumes at 0° and 20° C. are in the ratio of $1 : \frac{293}{273}$, or of $\frac{273}{273} : \frac{293}{273}$, that is of 273 : 293. Therefore the volumes of the gas are as their absolute temperatures.

This is an alternative way of expressing Charles's Law. In experimental work all temperatures are "reduced" to 0° C. or 273° A.

Thus to calculate the volume at 0° C. (V_0.) of a gas which measures 17 c.c. at 12° C., we must first convert the temperature into the Absolute scale. 0° C. = 273° A. and 12° C. = 273 + 12 = 285° A. Since the volume varies directly as the absolute temperature,

$V_0 : 17 = 273 : 285 \therefore V_0 = \frac{17 \times 273}{285} = 16{\cdot}3$ c.c.

Such reductions to "normal" temperature are usually made at the same time as the reduction of the volume to normal pressure.

To find the volume at normal temperature and pressure (N.T.P.) of 72 c.c. of nitrogen measured at 15° C. and 764 mm.

The reduction factor for the pressure is $\frac{764}{760}$ and that for the temperature $\frac{273 + 0}{273 + 15} = \frac{273}{288}$. Therefore the volume at N.T.P. will be $72 \times \frac{764}{760} \times \frac{273}{288}$ = 68·6 c.c.

Every gas known to the chemist has been liquefied by the application of sufficient pressure at the necessary temperature. The temperature above which a gas cannot be liquefied, however great be the pressure upon it, is called the *critical temperature*. The pressure necessary to liquefy a gas at its absolute temperature is called the *critical pressure*.

The critical temperature of hydrogen, one of the most difficult gases to liquefy is — 241° C, and its critical pressure 20 atmospheres. (*See also* "Heat," Vol. I., pp. 277, 278.) E. H. T.

LIGHT.—II

3. Intensity of Light. — We are all familiar with the fact that sources of light differ in brightness, and this difference may be ascribed to their emission of different amounts of light-energy. The illuminating power of a source of light at a given distance is obviously dependent upon its initial amount of light-energy, and we must now try to give definiteness to the point.

Suppose E to be the amount of light emitted by a source of light. This light we suppose to be radiated equally in all directions, as it will be in a homogeneous medium. Hence at a distance a from the source it will be spread over a sphere of radius a, and area $4\pi a^2$. The amount of light on a unit area of this sphere will therefore be $\frac{E}{4\pi a^2}$. As it continues to spread, we may similarly see that at a distance b from the source the amount of light per unit area will be $\frac{E}{4\pi b^2}$. Now the intensity of light at any point is defined as the amount of light falling on a unit of area containing the point. If then I_a and I_b stand for the intensities at points distant a and b from the source,—

$$I_a : I_b = \frac{E}{4\pi a^2} : \frac{E}{4\pi b^2}$$

$$\text{or, } I_a : I_b = \frac{I}{a^2} : \frac{I}{b^2}$$

$$\text{or, } \frac{I_a}{I_b} = \frac{b^2}{a^2}.$$

This is the *Law of Inverse Square*, which, put into words, states that *the intensity of light at any point is inversely proportional to the square of its distance from the source*. If we double the distance, the intensity falls off fourfold; if we treble the distance, it diminishes ninefold; and so on. The illuminating power of a lamp one yard away is four times what it is at a distance of two yards.

This law of intensity or brightness is very important in optics.

1. To illustrate it, cut a square in a sheet of cardboard: a square inch is a convenient size. Cover a lamp with a cardboard screen containing a very

small hole which is to be placed so that it lets through the light from the most intense part of the lamp. Take a third sheet of cardboard and fix it at twice the distance from the source of light at which the sheet containing the square is fixed. A square patch of light will be formed on the cardboard screen, and on measurement its area will be found to be 4 square inches.

Move it about, and measure the area of the square at various distances.

Incidentally, observe that this experiment also shows that light travels in straight lines: otherwise the light that passes through the square would cover more or less than the 4 square inches required by geometry. (Fig. 6.)

If a candle placed at a certain distance from a screen produces a certain illumination, I, four similar candles placed at the same spot

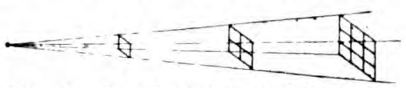


Fig. 6.—The intensity of light at any point is inversely proportional to the square of its distance from the source.

produce an illumination = 4I. Now suppose these four candles to be removed to double their distance: the illumination produced by them on the screen is then reduced to I. So that the four candles placed at a distance of two feet would have the same effect on a screen as one candle at one foot. To test this we need a *photometer*, or instrument for comparing the intensities of two sources of light.

A very simple one is *Bunsen's photometer*, which consists of nothing more than a sheet of white paper on which a spot of wax has been dropped. When the wax is scraped off with a knife, a spot of grease will remain on the paper.

Now, if this paper be held between the eye and the light, the grease-spot will show bright on a dark background. This is due to the fact that the paper itself is opaque, while the spot of grease is translucent and lets light through. But if the paper is placed with a dark background, with the eye and light both in front of it, the grease-spot looks dark on a lighter background, because it is now viewed by light diffused from the surface, and the paper diffuses more light than the spot. These preliminary observations should be made and their explanation mastered before proceeding further.

Now suppose that the paper is placed between two sources of light A and B, and viewed from the A side. If it is placed quite close to B, the grease-spot will probably stand out bright; as it is moved towards A, however, the spot becomes less bright, and near to A it will appear dark. Between these two limits will be found a place where the spot and paper are equally bright, and the spot is hardly distinguishable from the paper. At that place the illuminating powers of A and B on the greased paper are the same.

2. Use the Bunsen photometer to show that four candles at a distance of two feet produce the same illuminating effect as one candle at a distance of one foot, and thus verify the law of inverse square.

4. Photometry.—The illuminating power of any source of light is usually measured in terms of an arbitrarily chosen unit called the *candle-power*. When we say that a lamp is of 16 candle-power, we mean that it has the same illuminating effect as 16 of the standard candles. The standard in common use is not entirely satisfactory, but its convenience causes it to be maintained in practice. It is a sperm candle, such that six make a pound, and that burns 120 grains of wax per hour. Other lamps burning pentane, acetylene or amyl acetate, have been used as standards, but we need not consider them here.

Suppose the illuminating power of two sources of light to be E and E^1, and that they produce equal intensities on a screen distant a and b from them. Then—

$$\frac{E}{a^2} = \frac{E^1}{b^2}$$

$$\text{or, } \frac{E}{E^1} = \frac{a^2}{b^2}.$$

If E^1 is the illuminating power of the standard candle, then the candle-power of the other lamp will be E, and $= \frac{a^2}{b^2}$. Thus what we have to do is to measure the distances a and b when, with a Bunsen photometer, we find the illuminating powers equal.

Example.—With a gas flame at a distance 40 cm. and a standard candle at 16 cm. the grease-spot vanished. Hence, candle-power of gas flame $= \frac{40^2}{16^2} = \frac{1600}{256} = 6\frac{1}{4}$.

N.B.—The result should be checked by using other distances.

Bunsen's photometer is accurate enough for most purposes, but other photometers are sometimes employed, and the student should himself try them, and compare the results with those obtained from the greased paper. People differ

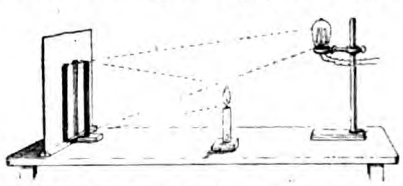


Fig. 7.—Rumford's photometer.

a good deal in their optical judgments, and some have great difficulty in deciding when two objects are equally illuminated.

Rumford's photometer, for example, is quite simple in theory, but with some observers it is extremely erratic in practice. A round rod—e.g. the upright of a retort stand—is placed near a white screen, and the light from each of the two sources is made to throw a shadow on the screen. Now the shadow cast by source A will be illuminated by the source B, and vice versa. Hence we manipulate A and B until we have the two shadows equally illuminated.

Errors of judgment will creep in here unless the two shadows are made to fall near together, as in Fig. 7. Even then it needs care to decide the

point of equal depth in the shadows, especially when the lights are not of the same tint.

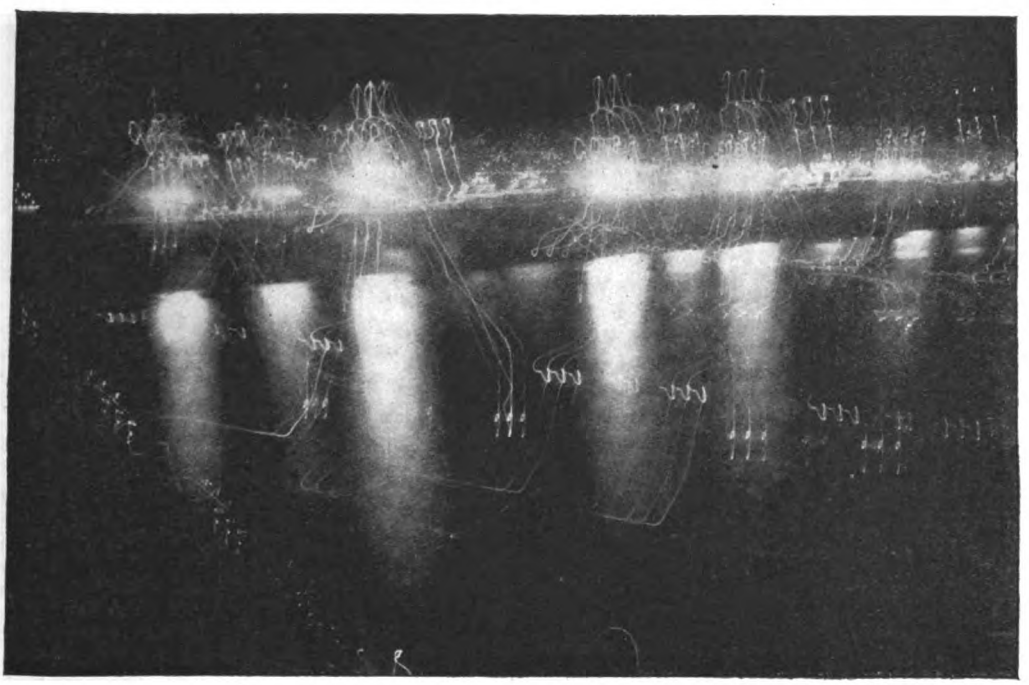
As an example, a gas flame at a distance of 32 cm. and a standard candle at 13 cm. produce the same illumination on the screen. The intensity due to the gas is $\frac{E}{32^2}$; that due to the candle, $\frac{E'}{13^2}$; hence $\frac{E}{1024} = \frac{E'}{169}$. But $E' = I$, $\therefore E = \frac{1024}{169} = 6\frac{10}{169}$.

The gas-flame is of 6 candle-power.

The slot photometer suggested by Prof. Silvanus Thompson is even simpler and quite as accurate as either Bunsen's or Rumford's. It consists of two strips of cardboard arranged in the form of a V, so that it easily stands on the table. The front limb of the V has a series of parallel slots in it (Fig. 8). The lights to be compared are arranged so that the front of the slotted limb is illuminated by one of them, and the inside of the whole limb by the other. Now if we look through the slots to the cardboard behind we shall find usually that the slots either look dark on a white background or bright on a darker background. We therefore adjust the lights until the slots seem equally bright with the background. When that happens, it is clear that the inner limb of the V is equally illuminated with the front of the other limb.

The measurements should be made to the middle slot. Then the slots to the left will appear a little darker, and those to the right a little brighter than the background. The lights should also be arranged so that the lines joining them to the faces they are illuminating should make equal angles with those faces. The inner side of the slotted limb should be painted over with Indian ink to avoid reflexion.

Joly's photometer is more accurate than any when lights of different tint are compared. Two small equal slabs of paraffin-wax are placed face to face with a sheet of tinfoil between them. The combined block is set up symmetrically between the two lights that are to be compared, and their edges are viewed. The wax is translucent, and spreads the light sidewise, so that when the two edges are equally illuminated the intensity due to each of the two lights is the same. The principle of the calculation is the same, of course, as in the other cases. (Fig. 9.)



AN INTERESTING STUDY IN LIGHT.

Brighton Pier photographed at night. The curious streaks of light are due to the photographer having omitted to cap the lens of his camera before moving the instrument, thus showing the electric lamps on the pier to be powerful enough to make an almost instantaneous impression on the plate.

5. Reflexion.—When light falls on a highly polished or smooth surface it is wholly or partially *reflected*, and the result is that images of objects can be observed in that surface. Almost perfect and complete reflexion takes place from the surfaces of polished metals, which are then described as *mirrors*; a duller surface partly absorbs the light, while the surface of water or glass reflects perfectly a little of the light, and transmits the rest.

Objects viewed in plane mirrors give what are called *virtual* images, i.e. images which are not really there, but only *seem* to be behind the mirror. We receive rays of light from the surface of the

mirror only, but they enter the eye as if they were diverging from a point or points behind the mirror, and it is when rays thus seem to be diverging from such points that the image is virtual. But curved mirrors under some circumstances cause the light, after reflexion, to converge to a point in front of the mirror; a *real image* is then formed which is a real and definite source of light.

Fig. 8.—Slot photometer.

Suppose a ray of light A B (Fig. 10) to fall on a mirror at B, and to be reflected from the mirror in direction B C. Draw B D perpendicular to the mirror at B. Then the angle A B D is called the *angle of incidence* of the ray; the angle C B D is called the *angle of reflexion*; and B D is referred to as the *normal* to the surface at B.

The two laws of reflexion may then be stated thus: (1) *the angle of incidence is equal to the angle of reflexion*; (2) *the incident ray, the reflected ray and the normal are in the same plane.*

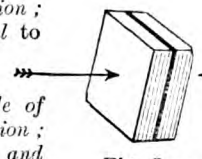


Fig. 9.—Joly's photometer.

A simple experiment in proof of these laws must here be made. Take a rectangular piece of silvered glass, as thin as possible, and stand it vertically on a sheet of white paper pinned on to a drawing-board. In front of the mirror fix two pins, P Q, so that the line joining them strikes the mirror obliquely at M. In the mirror will be observed virtual images of P and Q,—P′ and Q′. Take now a third pin, R, and fix it in the paper in such a position that R Q′ P′ is a straight line: this, of course, is done by observation. M R will now indicate the direction of the ray which is incident in the direction P Q M, and is reflected from the mirror. Draw the lines P Q M and M R on the paper; and draw the normal M N. On measuring the angles P M N and R M N, they will be found to be approximately equal. Repeat the process with different positions of P and Q.

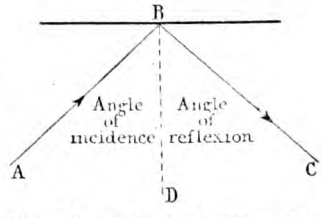


Fig. 10.—B is a mirror; B D a line at right angles to it; and A a ray of light. Then angle A B D = angle of incidence; angle C B D = angle of reflexion.

If P and Q are fixed with their heads at the same height above the paper, we can show experimentally that the head of M must also be at the same height if it is to cover the images of the heads of Q and P. Thus the second law of reflexion is proved.

If several rays incident from P on to a plane mirror are drawn, and their course after reflexion is determined according to the law of reflexion, it will be found that the reflected rays all intersect if produced at *one* point behind the mirror. It is at that point that the virtual image of P appears to be formed. Join P P′, cutting the mirror at X. It can now be proved by geometry and verified by measurement that P X = P′ X and that P P′ is perpendicular to the mirror. Hence, the virtual image of a point in a plane mirror is situated at a point equidistant with P from the mirror. This should be tested by the student both with pins, as above, and by geometrical construction. (Fig. 11.)

Every point on an object forms its image according to the same rule. It is thus easy to draw the image in any given case, as in Fig. 13. Similarly we can understand why the image seen is *laterally inverted*, the right side appearing to be the left side; and why the image of oneself is seen facing the opposite direction to the real one. Put your writing-paper near a mirror, and write your name according to the copy seen in the mirror. Or write something in ink and blot it; the writing on the blotting-paper is inverted, but will look correct when viewed in a mirror.

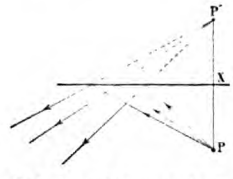


Fig. 11.—Demonstrating geometrically that reflected rays if produced all intersect at one point behind the mirror.

Of course the formation of an exact image depends upon the surface being geometrically plane; if it is rough, it reflects the light irregularly, i.e. scatters it without forming a definite image.

E. W. E.

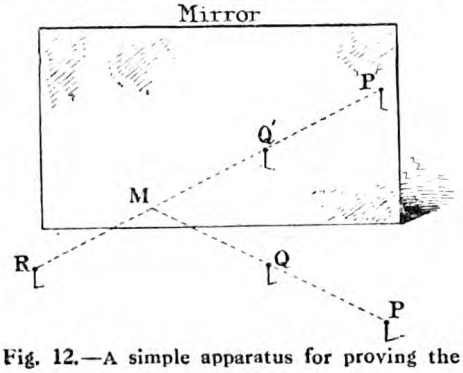


Fig. 12.—A simple apparatus for proving the laws of reflexion.

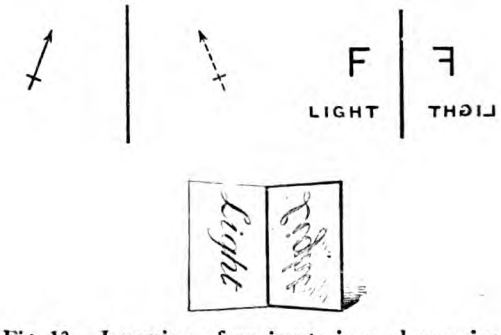


Fig. 13.—Inversion of an image in a plane mirror.

ELECTRICITY AND MAGNETISM —II

Natural and Artificial Magnets.—The name Lodestone (leading stone) has been applied to the only substance existing as a magnet naturally. Chemically this substance consists of iron and oxygen combined in the proportion of three atoms (extremely small particles) of iron to four atoms of oxygen. This fact is expressed by the formula Fe_3O_4, in which Fe represents iron and O represents oxygen, a substance that exists in the gaseous condition at ordinary temperatures when it is not combined with iron or some other substances. Another name for lodestone is magnetic oxide of iron, and on account of its magnetic properties it is known as magnetite by mineralogists. This mineral is found in Asia Minor, North America, Sweden and Spain, but it is not always magnetic. Its magnetic properties are feeble compared with those of iron and steel, and it is more of a curiosity than a useful material. Artificial steel and iron magnets compose the fundamental parts of the useful and wonderful electrical appliances of modern times—telephones, dynamos, electric railways, X-rays, wireless telegraphy, and many others which will claim our attention in due course.

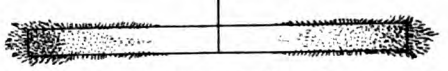


Fig. 2.—Are all parts of a bar magnet equally magnetic?

Magnetic Substances and their Properties.—In order to investigate the magnetic properties of iron and steel, the only substances which exhibit magnetism in any marked degree, we shall require a few pieces of simple apparatus—two bar magnets, iron, steel, and brass filings, a few small iron nails, fragments of watch-spring, or small keys, and a glass test-tube. Such a tube may be obtained from any chemist, the watch-spring from a watchmaker, and the bar magnets should be obtainable at any shop selling electrical apparatus, or through an ironmonger, who would also supply the iron filings, etc. The magnets need not be of large size, but must be in the straight "bar" form, though a curved horseshoe magnet, obtainable at a toy-shop, will be of use for later experiments. There will be occasion to suspend the bar magnets, for which purpose a single silk fibre should be used, since no torsion or twist in the suspending material must be allowed to interfere with the freedom of action of the suspended magnet. Heavier magnets may be placed upon a flat piece of wood, and floated on water. A small compass, which is merely a thin bar magnet mounted on a sharp point and therefore free to move in a horizontal plane, will be useful.

It is well to note at the beginning of our investigations that all experiments and measurements with magnets should be performed on a table removed from such things as iron pipes, weights, steel machines, etc., as these would modify the results of experiment and lead to miscalculations.

To determine whether a substance has magnetic properties or not, a very simple test is all that is required. By plunging one end of a bar magnet into filings or fragments of the material in question, the adhesion of the filings indicates magnetic properties. In this way it is shown that iron and steel are strongly magnetic, the less common metals nickel and cobalt are feebly magnetic, and that all other substances, metals and non-metals, possess no appreciable magnetism. It would not be quite correct to say that all of these other substances are absolutely non-magnetic, since Faraday has shown that all substances are either very feebly attracted or repelled by very powerful magnets, but the magnetic properties of materials other than iron, steel, nickel and cobalt are so extremely feeble as to be imperceptible without the aid of very powerful and special apparatus.

For practical purposes nickel and cobalt may also be eliminated, so that our studies will be devoted to the magnetism of iron and steel only.

Experiment 1.—*To see if all parts of a bar magnet are equally magnetic.*

Arrange a sufficiently long heap of iron filings, attach the silk fibre to the middle of one of the bar magnets, and lower it into the filings. On withdrawing the bar we notice that there is a cluster of filings at each end, but that there are few, if any, adhering to the middle portion of the magnet. Again, select a key or iron nail which can be supported by either end of the magnet, and then see how far towards the middle it can be placed without falling off.

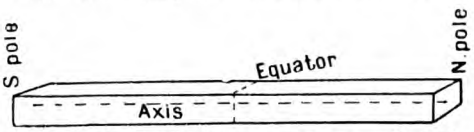


Fig. 3.—The ends of a magnet are called the Poles; the middle portion, the Equator; an imaginary line joining the poles, the Magnetic Axis.

The magnetism near the middle of the bar will be too feeble to support the key; and if the same experiment is performed with any number of magnets, one after another, a similar result will be obtained in each case. Later we shall see that there *is* magnetism at the middle of the bar, but that it is not free to influence external magnetic bodies. Our experiment shows that in any magnet the available magnetic influence, or *free magnetism*, as it is usually termed, is not uniformly distributed throughout the length of the magnet. The two positions near the ends, where the free magnetism is greatest, are called *poles*, and the middle portion, where it is least, is called the *equator* of the magnet. An imaginary line extending lengthways through the magnet and connecting the poles is known as the *magnetic axis* of the bar.

Are the two poles of a magnet exactly similar in their magnetic properties? The cluster of iron filings attached to one pole seems to be equal in size to that attached to the other, also a key just supported by one end is also just supported by the other end. Evidently the two poles are of equal magnetic strength.

Experiment 2.—*To find out if both poles of a magnet always behave in exactly the same manner.*

Suspend the magnet and wait until it has come to rest, when one pole will be pointing to the northern side of the room, and the bar itself will extend in an approximately north and south direction, or, in other words, it will be set in the *magnetic meridian*, the magnetic north and south line which is nearly

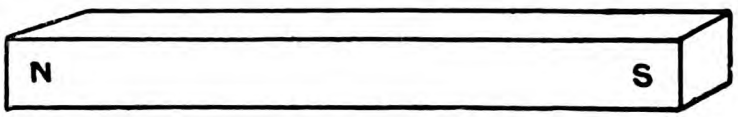


Fig. 4.—An iron nail placed near a magnetic pole will become a magnet; iron filings will adhere to it.

but not quite coincident with the geographical meridian.

Mark that end of the magnet which is pointing to the north, turn it round, then leave it to adjust itself. When the oscillations have ceased the same pole again points northwards.

In any magnet free to move in a horizontal plane, one pole always points towards the north, the other to the south, hence the names North pole and South pole by which they are known respectively. The letter N or the mark — on a magnet indicates which is its north pole.

Experiment 3.—*To illustrate the Law of Polarity.*

By means of the mark, or by experiment, determine the north pole of the other bar magnet, and bring it near the south pole of the suspended one. The result is mutual attraction; but if we place the north pole of one near the north pole of the other the result is one of repulsion. Similarly, on our bringing up the south pole of the second magnet to the poles of the other, we find that there is repulsion between the two south poles, but attraction between the south pole of one and the north pole of the other magnet.

Try the experiment with any other magnets, and similar results will always be obtained.

From this we deduce the important Law of *Polarity*:—

Like poles repel, unlike poles attract.

It is evident that the magnetic phenomena of attraction and repulsion are due to Polarity or the dual nature of magnetism.

The earth itself exhibits this polarity, for it behaves as if it were a huge magnet with its poles somewhere in the vicinity of the geographical north and south poles; and this explains why magnets free to move in a horizontal plane set themselves with one pole facing north and the other south. In reality that end of a magnet which points to the earth's magnetic north is of opposite polarity and is more correctly called the north-seeking pole, but by general convention the term north pole has been employed.

When magnets of very unequal strength are used in simple experiments, it may appear that the law of polarity is not always true. If the north pole of a strong magnet is brought near the north pole of a much weaker magnet, repulsion first takes place, then attraction between these two like poles may occur. This is not, as it appears at first sight, a contradiction of the law, for the influence of the stronger magnet has actually *reversed the polarity* of the weaker one, whose south pole now faces the north of the larger magnet—hence the attraction.

Induction.—The polarity of the weaker magnet, we see, was altered by the influence of the stronger one without there being any direct contact between them. It is a matter of common knowledge that a needle will jump on to the pole of a magnet held near it, and an iron nail placed near a magnetic pole will become a magnet itself, as can be shown by the adhesion of iron filings, etc.

The influence of the magnet extends through the intervening space and the nail, so that the magnetic properties of the latter have not been produced by any contact method but have been **induced**. This property, exhibited by any magnet, of inducing magnetism in other magnetic bodies is known as **induction**. When magnetism is induced in a piece of iron, it is found that **appreciable** magnetic properties remain in the iron only so long as it is under the influence of the inducing magnet, though some almost imperceptible **residual** magnetism remains in iron after it has been removed from the inductive influence.

Both the powerful temporary magnetism and the feeble residual magnetism of iron are of great importance in the working of useful electrical appliances. Unlike iron, steel once magnetized, whether by induction or contact, retains its magnetism as long as it is not roughly treated, or put away in a careless manner. Bar magnets should

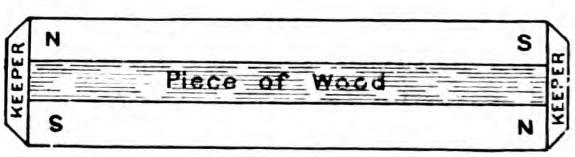


Fig. 5.—Bar magnets should be kept in a box with their poles so arranged that the polarity of each helps to preserve the magnetism in the others.

be kept in a box with their pole so arranged that the polarity of each helps the preservation of the magnetism in both. Iron "keepers" should be placed across the poles, thus preventing the magnetic influence from being diverted towards other external magnetic substances.

Simple Magnetization.—We will now use the simplest method of making a permanent (i.e. steel) magnet.

Experiment 4.—*To magnetize steel by the method of single touch, and to see if there is any relation between magnetism and the arrangement of particles composing the magnet.*

Put steel filings into the glass test-tube so that

THE BIRTH OF A GREAT INVENTION.

Signor Marconi, working with sheet metal "aerials" and "earths," engaged on one of his early experiments in the garden of his father's villa at Pontecchio. To Marconi belongs the credit of making wireless a practical proposition; he took out his first patent in England in 1896, and three years later had established wireless communication between England and France.

they are not packed too tightly, close the end of the tube, and hold it in a horizontal position. Now, if one pole, say a north, of a bar magnet is drawn along the glass from one end of the tube to the other, then lifted well away from the tube, and the same motion is repeated several times, always using the same pole, beginning at the same end of the tube, and moving in the same direction, the steel filings will set themselves in lines parallel to the length of the tube, and the arrangement will be a magnet exhibiting the properties of attraction, repulsion, and induction. The under side of the tube should be stroked in the same way as the upper side was, and by the same pole. Shake the tube so that the filings lose their linear arrangement, and the tube of filings loses its magnetic properties.

This linear parallel arrangement of filings in the tube, or of particles in a bar of steel or iron,

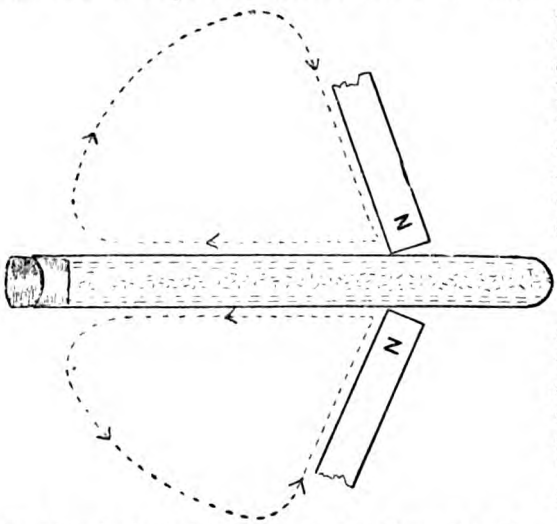


Fig. 6.—As indicated by the dotted lines, the N. pole of a bar magnet is drawn along the outside of a glass tube containing iron filings. Note how the filings arrange themselves.

appears to be a necessary condition for the possession of magnetic properties.

The permanent magnetism in steel is explained by the particles of a steel bar retaining their parallel arrangement, whereas in iron the particles retain the necessary arrangement only as long as they are held by the influence of a magnet. When experimenting with the tube containing steel filings we noticed that the essential linear parallelism was more or less confined to the surface layers of filings. This suggests that magnetism is situated chiefly on and near the surface of a magnet. That this is true may be proved by a simple experiment.

Experiment 5.—*To find out if magnetism is stronger near the surface of a magnet than it is in the interior.*

Magnetize a piece of watch-spring by the method of single touch, test its powers, then place it in strong nitric acid until the surface has been dissolved. On testing the remainder it will be found that its magnetism is more feeble than was that of the surface parts which have been removed by the acid. L. M.

ZOOLOGY.—XIII

No aspect of bird life makes a greater appeal to the imagination than the wonderful flight which we know as "migration." Yet, though this phenomenon is as old as man, it must be confessed that our knowledge concerning it is, at the best, incomplete, and often cannot claim to be anything more than conjecture.

Migration of Birds

That this should be so is partly due to the difficulty of investigating movements occurring sometimes as much as 10,000 feet above our heads. But a still more serious difficulty is presented by the enormous area over which these movements take place. If it were possible for us to scatter throughout the world a vast number of trained observers we could, by marking, liberating and subsequently recapturing many hundreds of thousands of birds, obtain exact data concerning those aspects of migration upon which at present we have no definite knowledge. Unfortunately it has never been possible to organise so great an effort, and such knowledge as we possess is largely the product of the countless theories which, since the days of the ancient Romans, ornithologists have never ceased to enunciate and to test. In short our information has been gained by a process familiar to students of Euclid, of disproving what is false.

The suggestion, frequently to be met with, that migration is limited to certain species of birds is on the whole a misleading one, since, if the term be used to indicate the journey from breeding area to winter quarters, practically all birds migrate. Whilst, however, the journey undertaken by certain species extends over thousands of miles, other species are content to move from the hills to the neighbouring valleys.

The origin of this wonderful movement, the vast extent of which, as will be seen, we are unable fully to appreciate, has been the subject of endless theories. Of these the most generally accepted is that the migration of to-day is the product of the journeys taken by the primitive birds in search of food. When the colony by reason of the nestlings became overcrowded, as was the case annually, certain of their number were compelled to wander farther afield. These doubtless passed from one feeding ground to another until the call of spring turned them back to their old nesting place. This process would be repeated year by year, but always the mi-

grating birds would tend to skip the indifferent feeding places and to hasten to others which they remembered as being more satisfactory.

So the process continued; new and better grounds were discovered, less satisfactory grounds were ignored. But these migrations were gradually modifying the powers of the participants. The birds that reached the feeding ground first had the best chance of surviving, thus there arose a tendency to cut corners when a definite spot was to be attained. Instead of arbitrarily following the coast line a slight deviation would be made across the sea, and as year by year the birds became more certain of their course the length of the sea journey when it shortened the total distance to be covered would increase.

Migration Routes

Equally as the length of continuous flight increased the weaker birds succumbed, and the species, generation by generation, attained greater powers of flight, and an increased ability to find their way from their nesting places to the distant land of plenty. This movement being advantageous to the species would become general, since those birds that did not conform to it would gradually die out. Undertaken originally as a measure of necessity and pursued for generations by the only birds that survived, the annual pilgrimage has become an instinct which asserts itself to-day even when unawakened by approaching winter and a shortage of food.

When we are called upon to say precisely where certain species will migrate to, and by what route they will travel, it is often necessary to answer in somewhat general terms. A very interesting instance of the perplexing movements of some species is recorded of the song thrush, which was for long regarded as a permanent resident in Great Britain. One song thrush nestling marked in Northumberland in July was found in November in Durham, another marked in Aberdeen in July was found in December in Portugal. Adult teal, released in Denmark in September and October, were discovered in places as widely separated as Scotland, England, Western France, Holland, the South of Spain and the North of Italy.

It will be seen, therefore, that with our present knowledge we cannot presume to lay down hard and fast rules as to the extent and time of the migration of some species. It is, however, fairly certain that some members of the so-called sedentary races migrate and that, on the other hand, certain members of some migratory species spend an occasional winter in our isles.

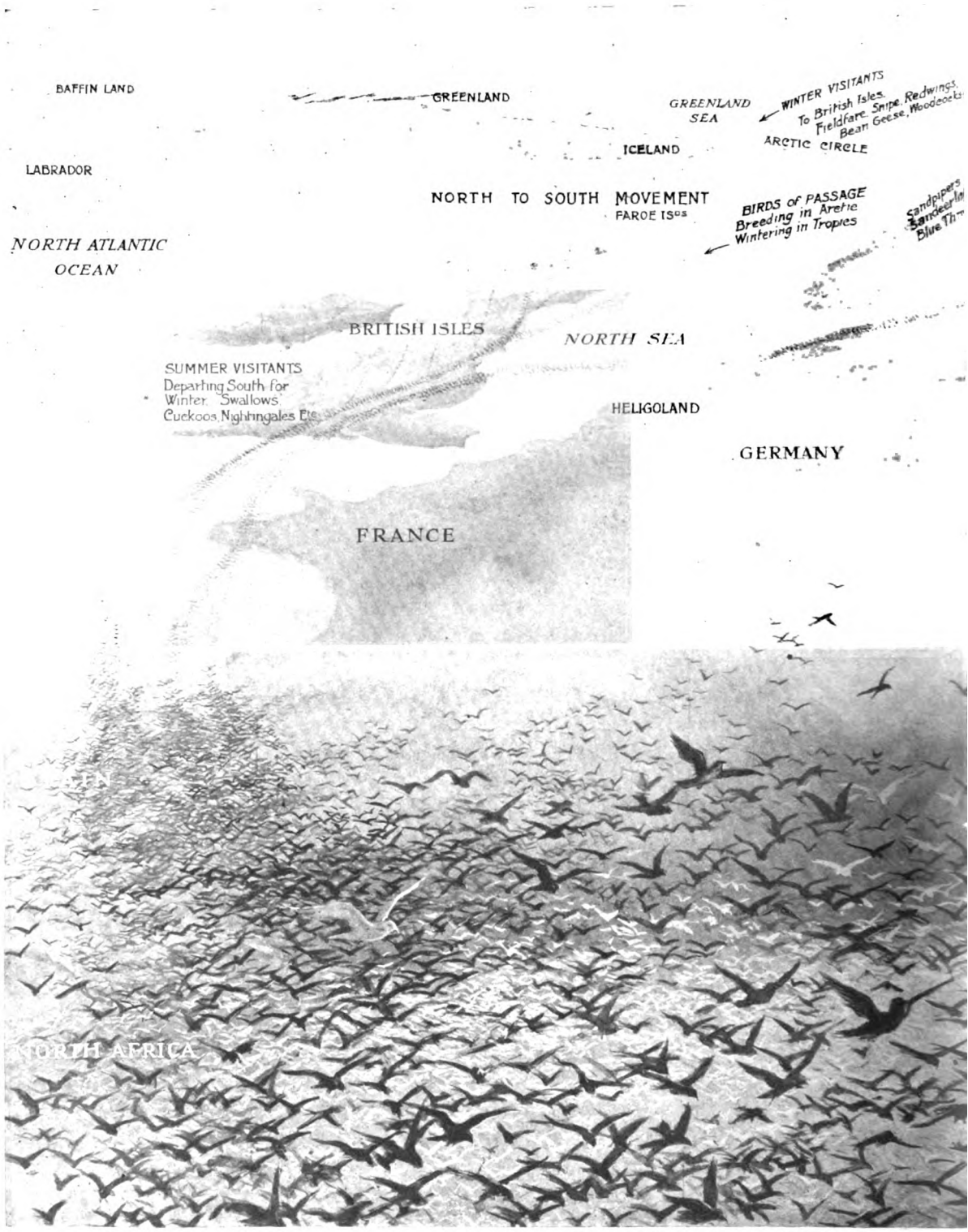
Again, birds of the same species do not, of necessity, migrate either at the same time or to the same area. The swallow, which, in Great Britain, is usually taken as typical of migrating birds, arrives at Cape Town at the close of October, and leaves again for the north at any time between the end of March and the middle of April. On the other hand, swallows reach Southern Europe from the south early in March, and by the middle of April are to be seen in England. From this it is clear that the birds nesting in England cannot be the birds which spend the winter in South Africa. The probability is that swallows nesting in England do not go much farther afield than the lands immediately south of the Sahara, and that the South African swallows are the birds which pass through England in May and June on their way to a more northerly nesting place. It is, in fact, now a generally accepted theory that the birds which travel farthest to the south in the winter, breed farthest north in the summer.

Birds in Flight

It is probable that the speed at which the migrating bird normally flies is by no means excessive, but it is clear that in this matter the strength of the air current with which or against which flight is made is of the utmost importance. For instance, a bird flying slowly at 10 miles per hour in a current moving at 20 miles per hour is progressing at a speed three times that which its expenditure of strength would secure in a calm atmosphere. A flight of 300 miles or so across the North Sea could, therefore, be made with the assistance of such an air current in the short space of ten hours, and that without exertion.

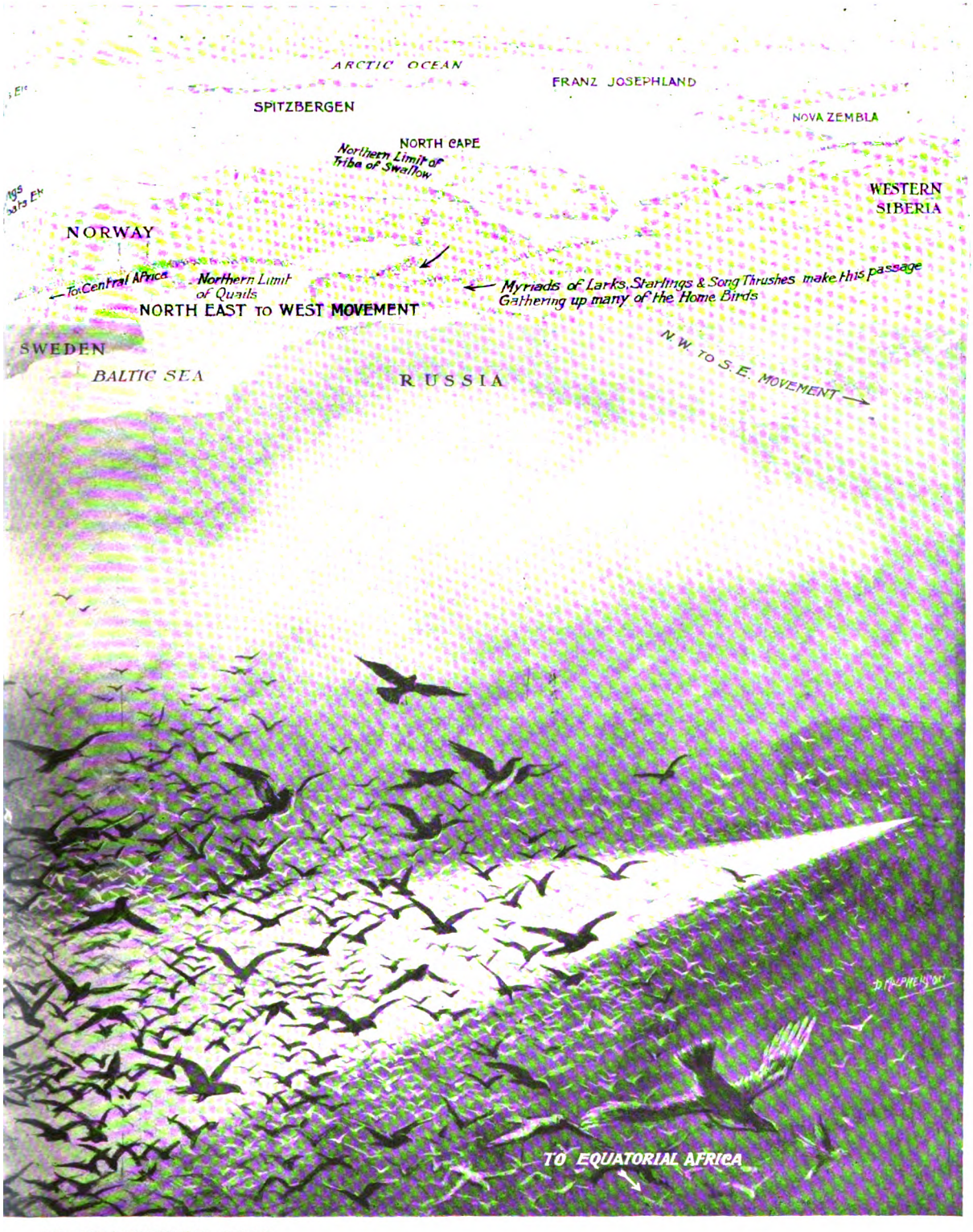
The stronger birds, which fly at a higher speed, would be able, of course, to accomplish the passage in much less time. A rate of anything from 100 to 150 miles per hour is by no means unusual.

It would appear that speed is usually increased in proportion to the distance to be covered before a suitable feeding ground can be reached. The precise use made of air currents by migrants is not yet fully determined. It has been suggested by eminent authorities that the bird is so well aware of the advantages to be derived from a favourable wind that it soars in search of it. However that may be, it



THE GREAT AUTUMN TREK

A pictorial chart showing the course taken by the myriad battalions of migrating birds. These form four cuckoos, nightingales, etc.); birds which come to the British Isles from the Arctic Circle during the winter must be considered the migratory movements of the host of



OF FEATHERED LIFE.

main divisions :—Birds which visit Northern Europe for the summer, going south for the winter (swallows, (snipe, woodcock, etc.) ; birds of passage which breed in the Arctic and winter in the tropics. In addition larks, thrushes and so forth from the uplands of Central Asia.

cannot be doubted that winds favourable and adverse are as important to bird life as the railway is to mankind. The comparison is, however, far from satisfactory, since the wind is far more uncertain than any railway service, however inefficient, could possibly become.

Air currents may convey the migrating bird safely and swiftly to his destination, but equally they may carry him a few hundred miles to the east or the west, or the north, or the south of it, as the case may be. But it has yet to be proved that this contingency ever deters birds from taking to flight. The only wind that suffices to bring migration locally to a standstill is apparently an excessively strong one. Observation made at the Eddystone Lighthouse by one of the greatest living authorities on bird migration established the fact that birds passed steadily with winds from all quarters, but that when the velocity of the wind exceeded 28 miles per hour, migration ceased.

The longest distance, so far as we are aware, covered in a single flight, is undertaken by several species of American shore birds. The American golden plover, which is one of the species concerned, nests on the Arctic coasts of North America. When the young are sufficiently grown the first stage of the journey is made south-east to Labrador. Here the birds have a feeding ground that suffices to supply their needs for a few weeks. After a time they move on, this time almost due south across the Gulf of St. Lawrence, to Nova Scotia, where another brief halt is made.

A Sea Flight of 2,500 Miles

Now follows a truly wonderful sea flight, which has probably developed by a process already indicated from a more lengthy journey along the coast; for from the moment the migrants take to the air in south-east Canada, they do not pause, unless compelled to do so by adverse gales, until they reach the coast of South America over 2,500 miles distant. It sometimes happens that strong adverse winds will cause a halt at the Barbados, the Bermudas or the Lesser Antilles, but in favourable weather the flight from Nova Scotia to Guinea is made without a break at a speed ranging from 150 to 200 miles per hour.

From the Guineas the southerly journey is continued across Brazil to the south-eastern regions of the Argentine, where at last this wonderful long-distance flight reaches its conclusion.

The return journey is made by a route considerably to the west of that just described; skirting Central America, the plover crosses the Gulf of Mexico, and makes its way up the Mississippi Valley and across Central Canada to its northerly nesting ground. While the extent of the migration of these birds is in itself remarkable it is not unique. What is truly amazing is the feat, which the southward journey involves, of a continuous flight of some 2,500 miles.

Birds breed in the colder areas of their migration. Then when food is difficult to obtain, and the nights become cold, and the young are advanced enough, they begin their flight southwards, e.g. the swallows migrate from Northern Europe to Africa.

Considerable differences of opinion exist amongst ornithologists concerning the nature of the routes which birds follow when migrating. One school is inclined to attach excessive importance to coast lines and rivers, another is content to credit the birds with an instinctive sense of direction, while still a third holds that there is something to be said for both theories.

Sense of Direction

While it is true that observation has recorded a steady flow of migrants along the shore line and above the course of important rivers, it is none the less true that certain birds make their annual pilgrimage over areas in which these geographical features are lacking. On the other hand, as regards the second theory, the constant appearance of individuals in areas to which the species is entirely foreign would seem to suggest that the sense of direction with which birds are rightly credited is less omniscient than it is popularly supposed to be.

The height at which migration takes place is unfortunately such that we see normally little or nothing of these great bird-movements. More often than not the passing of the bird-legions is only known to the trained observer by the stragglers who drop by the wayside. For hours at a time the constant arrival of these exhausted travellers will indicate the passage of a vast but invisible army overhead. When, however, adverse winds check the steady flow of migration or the glare of the lighthouse in foggy weather baffles the passing host, it is possible for us to gather from the thousands of birds which at such times make their appearance some idea of the millions which accomplish their journey without misadventure.

A. B.

ETHNOLOGY.—I

HAVING surveyed Man from the anthropological or physical aspect, let us now turn to the most wonderful of his characteristics, the development of his brain, of his mind.

Whereas in his body he is just one of the many mammals on the face of the earth, just a beast with a very large brain-case and abnormal brain, that walks on two legs instead of four, only grows hair to any extent on the top of his head and has no visible tail; in his mind, his brain development, he is, if not a god, at any rate a demi-god, and on the way perhaps—to put it picturesquely—to becoming an angel.

He is advancing along an upward path which has already made him virtually lord of the earth and may some day, far ahead of the present time, extend his influence elsewhere over the solar system. He may be, indeed, a god in the grain.

Often has this feeling emerged in the thinkers of the latter days of Man's history. Man is no longer earth-bound in his gaze and interests. We can imagine him, once he had entered the genus Homo, turning a questioning gaze on Sun, Moon, and Stars. Later he distinguished the wandering planets from the seemingly fixed stars, becoming staggered at comets and frightened at meteors. He took note of the thunder and of the lightning and began to think that above him beyond the clouds somewhere in the blue of heaven there must be a gigantic man, a being infinitely superior to himself in strength and yet in some way allied in thought, in passions, in intentions.

The Mystery of Death

He pondered over the mystery of death. Family love is acute already in the anthropoid apes, and even tribal love and common interest had arisen as far back as the stage of the baboons.

Did death end all in the way of human consciousness and individuality?

Was it possible that the aged chief of the clan so long accustomed to lay down his will over the community, first by physical force and next by accumulated knowledge and experience, perished completely when life departed from his body and that body visibly rotted?

Gradually, early Man began to believe that this was not so; that at any rate the important persons of the tribe, first no doubt the men, and next the wives and mothers, still went on living somewhere, even when breath had left the body. Their spirit, their "breath," as early Man would have phrased it, possibly inhabited the cave, the grave, the tree in which their mortal remains had been deposited. Or it entered some neighbouring river endeared to the tribe by its fish supply, or a spring grateful to the thirsty in an arid land, some reverenced mountain-peak, or sleeping lake, or—why not?—the sky itself. Might not the loved, the dreaded, or the revered great person of the tribe be one of the stars that looked down on them on clear nights?

The idea of God, the God of Heaven, seems to have arisen from a fusion of two lines of thought: the perpetuation of the human ancestor and ancestor-worship till the great-great-grandfather had either become an earth god or even a god of the sky; and the pre-existing and never quite obscured belief that there was some great Existence in the heavens whose voice was the thunder, whose sword was the lightning, and whose gift was the blessed rain which caused the grass to spring anew and the wild cattle to increase and multiply. Or this God of the heavens might be the Sun himself; or the Sun and the Moon be a heavenly husband and wife, with star and planet children.

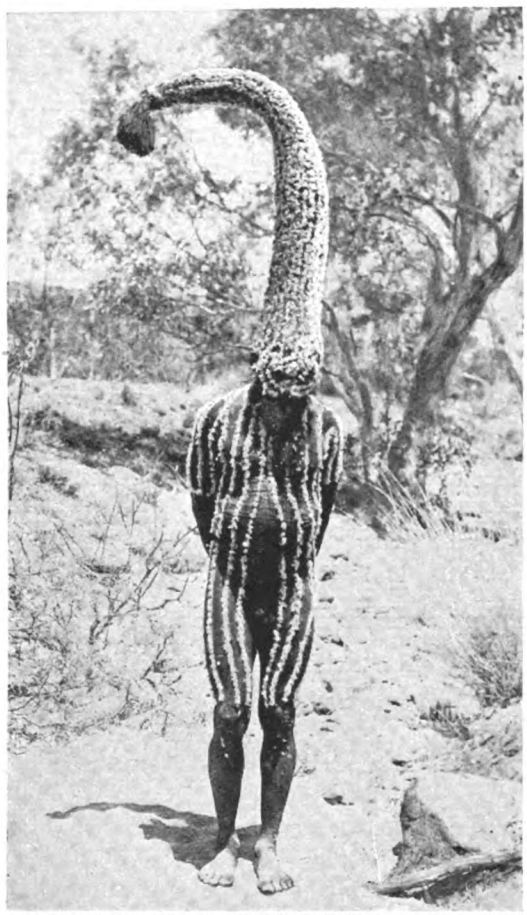
Religious Development

Yet more often than not even amongst savages God is distinct from the Sun and Moon, since neither lightning nor thunder proceeds from these heavenly bodies (at any rate in unscientific reasoning).

In the course of the long development of the human mind—half a million, three-quarters of a million, perchance a whole million of years—life has not been associated merely with animals that move or plants that grow. Man has even gone to extremes in far back periods, extremes we are again touching now in recent discoveries of science, in attributing life, even conscious life, to inanimate matter. In his thoughts he gave a personality to the mountain, to the flood, to the waterfall, the sea, the wind, the rainbow, the planets, the sun and moon, the whirling columns of desert dust, the very stones which he worshipped for their usefulness, their mysterious hardness, their impermeability. Or if they were not living of themselves they were the chosen abode, the passing home of a deity. So there arose the idea of "fetish," of some inanimate substance or bundle of rubbish being the insignia or the home of godly power.

Dwarfish or giant human races condemned by physical or brain inferiority to a hidden

or a solitary existence became, in the eyes of the average man and woman of the dominant race, endowed with supernatural powers. They were elves, fairies, goblins, trolls, ogres, banshees and vampires. From these beginnings arose the religious beliefs of Man which have had such a potent bearing on the life of Man.



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A CRUDE EVOLUTIONARY IDEA.

An Australian aborigine wearing an Emu totem dress—made of down, the head-piece representing the neck and head of the bird.

Fundamentally, all religions are in close kinship, but sensible men and women—as Lord Beaconsfield once suggested—have but one type of religion, whether it be termed Christianity, Judaism, Muhammadanism, Buddhism, Hinduism, or Shamanism. It is a religion of bold yet reverent speculation concerning the mysteries of the universe, of trustfulness and hope, of humble admiration for the beauty around us, and above all of charity, charity towards other human beings and human races and towards all forms of life on the earth that are not in direct antagonism to Man.

Early Man had little racial pride about him; he was more catholic in spirit than many of his descendants. He felt small pity for the weak, it is true. His fidelity, his charity, his forbearance were at first confined within the limits of his family or of the tribe. With men, women and children outside the tribe he felt no more natural kinship than with the beasts of the field; less, perhaps; because the cave bear, the mammoth, the wolf, lion, leopard, beaver, eagle—any beast or even bird of striking appearance, of cunning, physical strength, or beauty—seemed more naturally his kin than brother savages on the other side of the mountains or across the strait of water.

Totemism

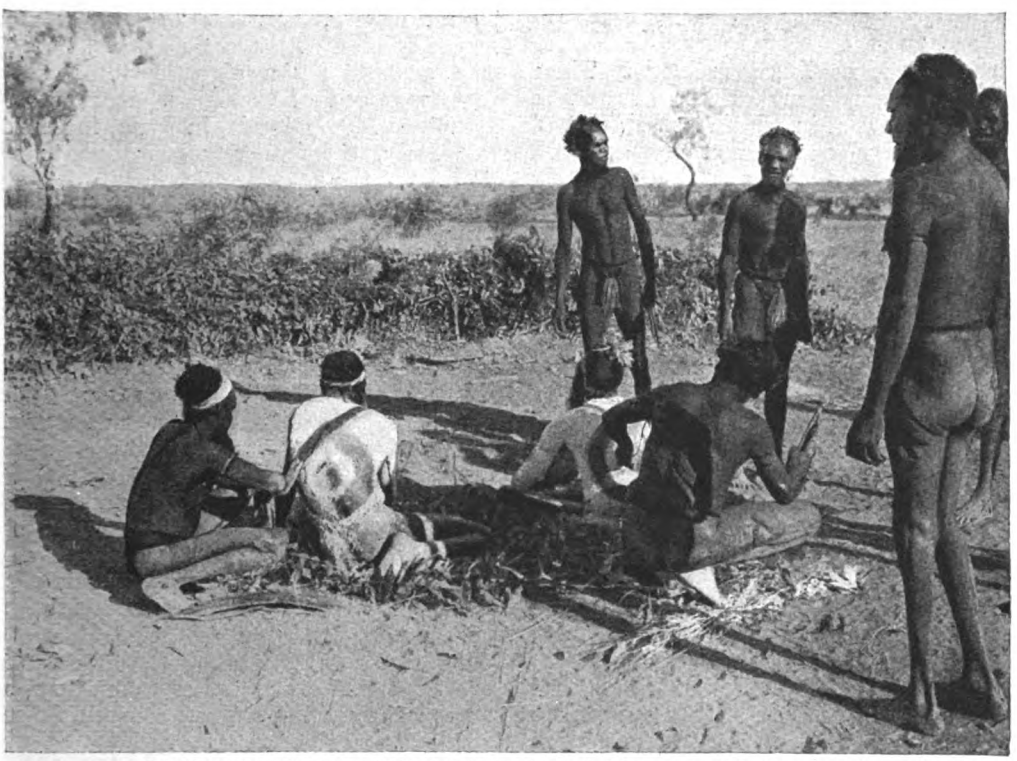
Just as people at the present day, very naturally and by no means blameably, may feel more true love and affection for a valued dog than for an uncle or a cousin, or a sister-in-law, so it was with early Man, and so it is with many savages at the present day; and though in subsequent developments Man has been thoroughly "Christian" in regard to all his fellow men and women, he has been unspeakably brutal towards other living creatures not within the human pale.

From this intense interest in the animal and even vegetable creation around him, early Man developed that curious system of totems which has permeated all humanity. For the crests and coats-of-arms which have descended to us from the days of chivalry are little else than an attenuated totemism. The totem was some natural object—animal chiefly, but also vegetable, and even mineral—from which the human person, clan or tribe, believed itself to be descended. Modern humanity sixty years ago expressed itself shocked at Darwin's suggestion that it had ascended from the anthropoid ape; but savage and unscientific humanity of earlier times or barbarous regions sees no shame whatever in conceiving of its ancestors as being the offspring of a snake, a fish, a lizard, a hyena, bear, tiger, or hippopotamus.

Lost human babies were occasionally taken pity on by a female ape, a female wolf, or some other mother-beast deprived of her young and yearning to yield her milk to something that cuddled about her. "Mowglis" have no doubt again and again been brought up in the jungle in foster-kinship with the jungle people; or desolate women have satisfied their maternal cravings by bringing

up young wolves or the puppies of wild dogs, young bears, fawns and piglings. And so has easily arisen the legend that there was a wild boar in the family, a monstrous wolf, a glossy bear, or a cur dog.

But early Man was emphatically the child of his hands. Whilst he worked with his hands he thought with his head; and whilst he was framing religions and speculating as to the descent of his grandfather or grandmother, he was becoming more and more ingenious as a manufacturer.



Reproduced from Spencer and Gillen's "Across Australia," by courtesy of the publishers, Messrs. Macmillan.

SOOTHING THE SIGN OF THE TOTEMIC ANCESTOR.

Men of an Australian tribe, the Warramunga, stroking the Totem sign which, in this case, is a snake, drawn on the back.

Ethnology at the present day as a science has two main divisions: a study of the products of man's mind, and a consideration of the products of man's hands.

It deals with his religions, his legends, his languages and literatures; his customs—which are universal under one name and another—his prejudices, his crimes and his splendid history of widening and developing love and charity. It deals also with his industries, his extending conquest over matter. It discusses the ceremonies with which he has surrounded his life from the cradle to the grave, his follies, his fancies, his superstitions; his medical precautions in the matter of child-bearing, child-birth, and the nurture of the infant; the games of childhood, the education of children, the customs attending the critical stage of puberty, when the child is passing into the adult man and woman—customs which may vary from the savage, disgusting, yet not altogether purposeless rites of initiation in Australia and Central Africa, to a solemn, a purified and a spiritual confirmation service of a princess in St. James's Palace or St. George's Chapel.

Ethnology discusses the increasing complications (followed, it may be, by greater and greater simplification) of the marriage ceremonies. Very early in the history of the human species Man began to surround the question of love and sexual union with far-reaching thoughtfulness.

Very early in his career he grasped the fact that inbreeding results in diminution of vigour in the descendants, so that marriage between son and mother, father and daughter, and above all, brother and sister, cousin and cousin, became tabooed, was considered

to be highly displeasing to the vague Powers in and outside the visible world. Also the trend of opinion ran in the direction of the sanctity of marriage and even (in spite of many relapses) in that of monogamy as opposed to polygamy; that is to say, that the right thing in society was for the man and woman who had joined in marriage to be faithful to one another and for the man to be the husband of but one wife.

Towards Sex Equality

There were, as I say, relapses. There have arisen conditions of life, avowed as well as unavowed, in which (as in Tibet at the present day) one woman is the wife of a whole family of brothers or of a small clan of men (this is known as "polyandry"), while in most of the barbaric regions of the world and in antique society (or society with an antique cast at the present day) one man may be the husband of any number of wives or concubines. Then there have been other strange developments of custom wherein communities of men and women live by themselves, the two sexes hostile to one another except it may be at one period, one month in the year. (This phase is illustrated in the Greek legend of the Amazons.)

All through our survey of Man's history as we can piece it out, we see one outstanding fact: the gradual rise of Woman to a position of equality with Man; equality in physical as well as mental development. Long before humanity started as the definite genus *Homo*, far back in anthropoid times, there was a marked disproportion in size, in beauty of face and body, in vigour, and in intelligence between male and female: the male was emphatically the superior animal. The male gorilla is nearly twice as large as the female, twice as strong, has a much more remarkable development of hair on head and face, is much more naked on the breast, and has much longer canine teeth.

In the days of *Eoanthropos* we should probably have noted nearly as much disproportion between man and woman. In the savage races at the present day of Africa, America, Asia, and in parts of the Continent of Europe, the men are much taller, much better looking, much cleverer, and more intelligent than the women. The male has also through these long ages of superiority become a great deal more selfish than the woman. A mere grabbing at all that is best in existence, best in the way of food and all other conditions of life, has retained for him this superiority.

Yet that curious inexplicable force, Religion, has been working on the side of the woman and of the child. Again and again it has been the attempt of new religious movements to enforce the rights of the woman to equality of treatment. Man's first—and perhaps last—conception of God is of a gigantic *man* in the sky. Indeed, when Jehovah has been painted audaciously by the Mediæval and Renaissance Italian painters, it has been as an elderly, bearded, patriarchal man. In the opinion of the early Jews "Jahveh" was undoubtedly a gigantic and despotic male monarch of the skies. Yet in early Egypt, in Mesopotamia, in Syria, in Greece, and Italy, the tendency has been to put Woman in the heavens also.

In Aryan Europe, as likely as not, the universe was occasionally conceived of as governed by a Woman god, and this belief reappears often in the mythology of the Pacific archipelagoes and of Eastern Asia.

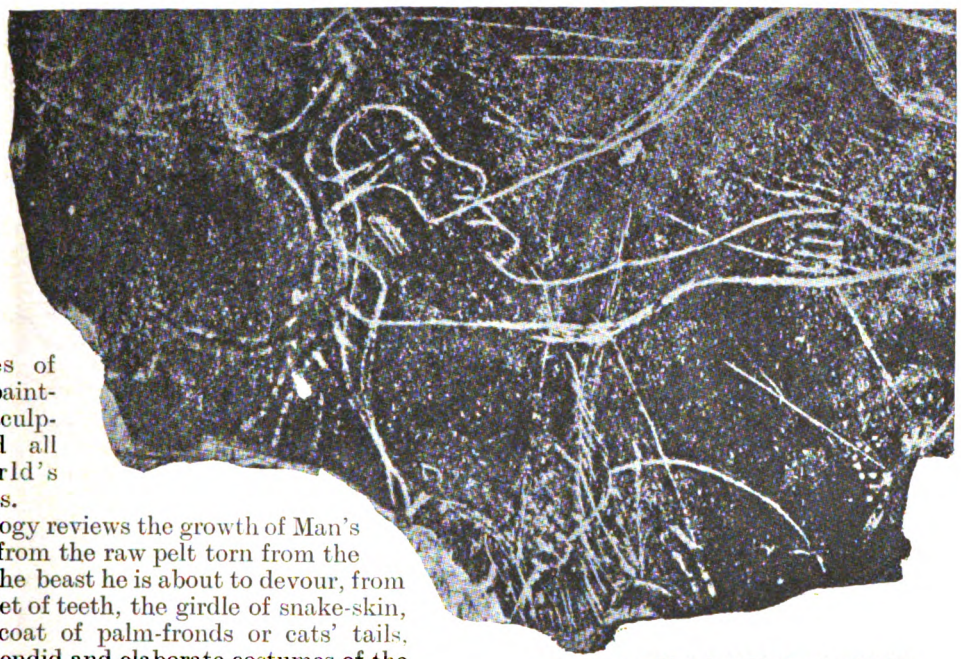
If the great fact of marriage created innumerable customs which Ethnology now studies and compares, scarcely less, or less remote, attention was directed to death and burial. Early Man must have begun to bury his dead with some ceremony almost before he was a true Homo.

Love had already grown up in the anthropoid clan or between anthropoid spouses and parents. The corpse of the child or of the beloved mother or father could not be left to the wild beasts, or allowed to decay as an offence to the nostrils. It was extended or folded into a sleeping position, wrapped up in bark or in skins, put into a hole or a house dug in the ground, or protected by a cairn, a dolmen of stones; and with it were buried its favourite adornments in life, its weapons and implements, and supplies of food.

From Log Craft to Ocean Liner

The Ethnological range of Man's industries is now gigantic. It extends from the first log hollowed by fire or by stone-axe to the super-dreadnought and the ocean liner, from the dolmen and the trilithon to St. Paul's Cathedral and the thousand-feet-high buildings of New York; from the rudely-chipped flint implement to the Nasmyth hammer, to the perfection of surgical implements, to the cutting of diamonds, the wood-pulp machinery, the iron foundries and the electric power stations. It expands from the first sign and symbol inscribed in charcoal or blood on the pebble or the rock to the linotype press; from the rude pictures of the mammoth or the figurine of a woman in soap-

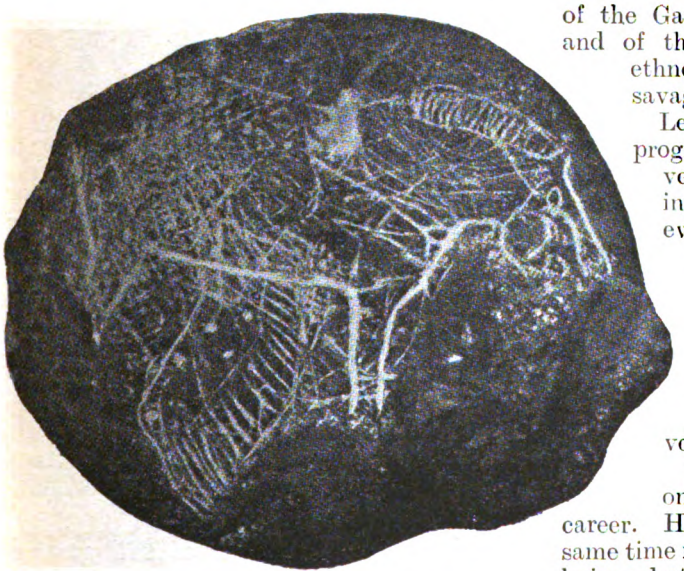
stone, or of the crawling, hairy, human hunter, of the salmon, of the reindeer and the bison, to the masterpieces of modern painting and sculpture and all the world's literatures.



From a Photo by MM. Mayet and Cottin

Probably the most ancient existing drawing of a man. A human face engraved (actual size) on the shoulder blade of a mammoth, discovered in 1913 near Colombière in the valley of the Ain in S.E. France.

Ethnology reviews the growth of Man's costume from the raw pelt torn from the body of the beast he is about to devour, from the necklet of teeth, the girdle of snake-skin, the petticoat of palm-fronds or cats' tails, to the splendid and elaborate costumes of the Middle Ages and the Renaissance, of the high priest, the monarch, the statesman and the actor; from the mystic amulet of bone, tooth, gizzard or uncut diamond on the chest of the savage medicine-man, to the more or less silly adornments of the modern Freemason. The Order of the Bath, the Order of the Garter, the Order of the Elephant and of the Holy Ghost, all go back by ethnological tracing into remote and savage times.

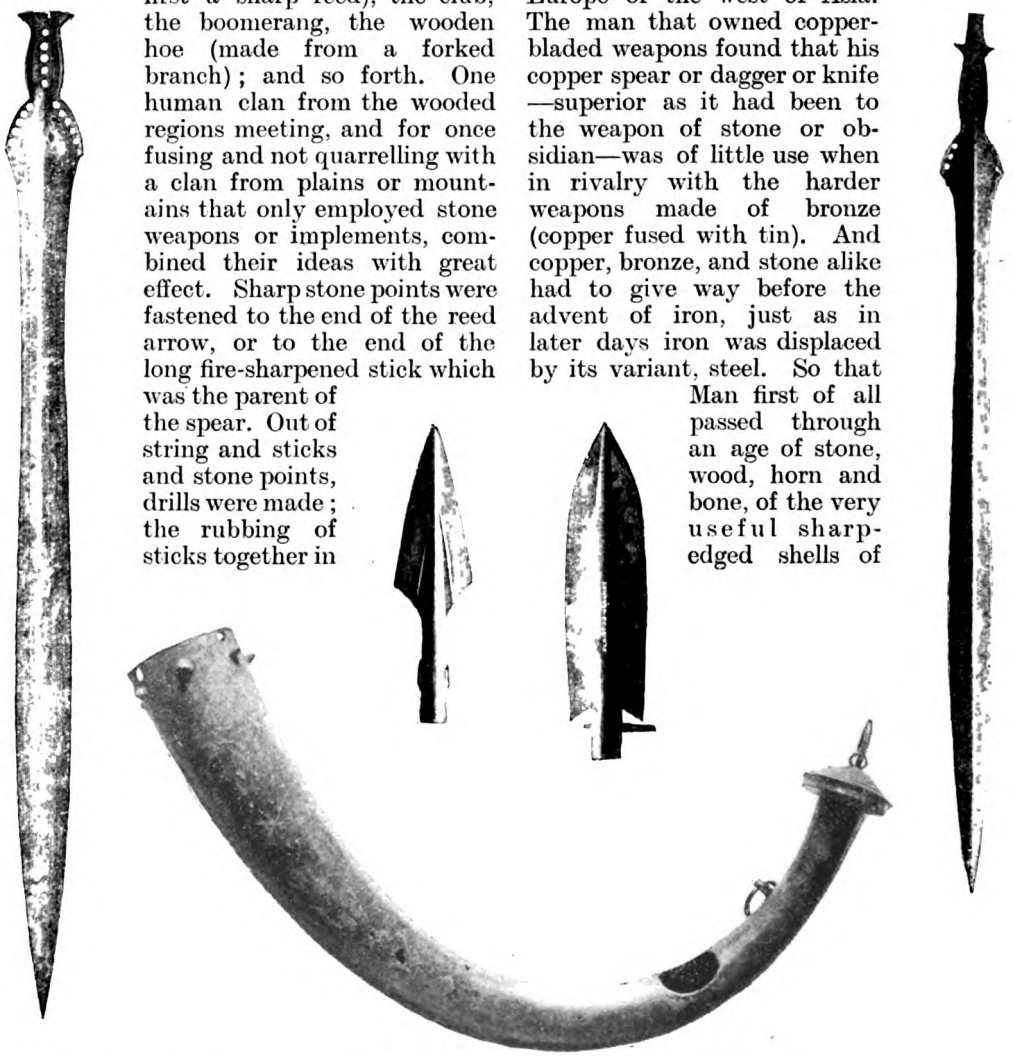


A stone engraved with the figure of a horse also found at Colombière. The engraving is very much more realistic than that of the human head shown above.

Let us follow in imagination the progress of more humble human inventions, taking weapons as the first instance. Before Man was definitely evolved, he had learnt to throw stones. When the semi-ape dashed one rock against the other he found that one or other of the rock lumps often split cleanly into a number of sharp-edged fragments which were of a size and shape convenient for grasping in the hand.

When he realized this he had taken one of the great steps in his upward career. He also discovered much about the same time not only how to make these natural knives, but how to use sticks and vegetable fibre. He noticed that when supple branches were held back and released, they struck with considerable effect, that bamboos if split would furnish sharp-pointed weapons; that certain rinds stripped off the stems of trees provided stretchable fibre which could be used for snares and bow strings.

Putting all these ideas together in the course of centuries and centuries, he evolved the primitive snare, the bow, the arrow (at first a sharp reed), the club, the boomerang, the wooden hoe (made from a forked branch); and so forth. One human clan from the wooded regions meeting, and for once fusing and not quarrelling with a clan from plains or mountains that only employed stone weapons or implements, combined their ideas with great effect. Sharp stone points were fastened to the end of the reed arrow, or to the end of the long fire-sharpened stick which was the parent of the spear. Out of string and sticks and stone points, drills were made; the rubbing of sticks together in a variety of forms had provided Man with artificial fire.



Some specimen Bronze Age instruments preserved in the British Museum. The trumpet came from Dunmanway, Ireland; the longer of the two swords was found in the Medway, the shorter in the Lea. The broad spear head was found in Plaistow Marshes, the other at Naxby, in Lincolnshire.

In course of time the search for stones almost of necessity brought about acquaintance with minerals, and accidental fires discovered the process of smelting; so that mineral substances which could not easily be hammered, might by melting assume the shapes required. First copper, then zinc and tin, were made use of by Man (as well as gold and silver for adornment), and lastly came the great discovery of how to use iron.

This may have been quite late in human history and have taken place (as already indicated) somewhere in the north-east of Europe or the west of Asia. The man that owned copper-bladed weapons found that his copper spear or dagger or knife—superior as it had been to the weapon of stone or obsidian—was of little use when in rivalry with the harder weapons made of bronze (copper fused with tin). And copper, bronze, and stone alike had to give way before the advent of iron, just as in later days iron was displaced by its variant, steel. So that Man first of all passed through an age of stone, wood, horn and bone, of the very useful sharp-edged shells of molluscs, of fish's teeth, of mammals' teeth, of stags' antlers, and even of birds' beaks; and next entered the metal age.

He is now on the eve of still greater changes, the more complete harnessing of gases, of the atmosphere, of the sun's rays and of electricity. The stone knife grew into the metal sword; the crossbow into the gun.

Here was one of the first utilisations of gas, of the powers of rapid expansion in certain elements. H. H. J.

Continued from page 289.

LANGUAGES:

Contributors:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A.[Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).

LATIN.—XIV

Third Conjugation *(Continued)*

3. PERFECT formed by adding **s**:

PRESENT.	PERFECT.	SUPINE.	INFINITIVE.	
combūrō	combussī	combus-tum	combūr-ĕrĕ	*burn up.*
carpō	carpsī	carptum	carpĕrĕ	*pluck.*
dēcerpō	dēcerpsī	dēcerptum	dēcerpĕrĕ	*pluck off.*
cēdō	cessī	cessum	cēdĕrĕ	*give way.*
cingō	cinxī	cinctum	cingĕrĕ	*gird.*
claudō	clausī	clausum	claudĕrĕ	*shut.*
includō	inclūsī	inclūsum	inclūdĕrĕ	*include.*
dēmō	dempsī	demptum	dēmĕrĕ	*take away.*
dīcō	dixī	dictum	dīcĕrĕ	*say.*
dīlĕgō	dīlexī	dīlectum	dīlĭgĕrĕ	*love.*
intellĕgō	intellexī	intellec-tum	intel-lĕgĕrĕ	*under-stand.*
extinguō	extinxī	extinctum	extinguĕrĕ	*extinguish.*
dīvĭdō	dīvīsī	dīvīsum	dīvĭdĕrĕ	*divide.*
dūcō	dūxī	ductum	dūcĕrĕ	*lead.*
fīgō	fixī	fixum	fīgĕrĕ	*fix.*
fingō	finxī	fictum	fingĕrĕ	*mould.*
flectō	flexī	flexum	flectĕrĕ	*bend.*
conflīgō	conflixī	conflictum	conflīgĕrĕ	*strive.*
inflīgō	inflixī	inflictum	inflīgĕrĕ	*strike against, cast down.*
flŭō	fluxī	fluxum	flŭĕrĕ	*flow.*
gĕrō	gessī	gestum	gĕrĕrĕ	*carry, do.*
iungō	iunxī	iunctum	iungĕrĕ	*join.*
laedō	laesī	laesum	laedĕrĕ	*hurt.*
aspĭcĭō	aspexī	aspectum	aspĭcĕrĕ	*look at.*
collīdō	collīsī	collīdum	collīdĕrĕ	*dash together.*
lūdo	lūsī	lūsum	lūdĕrĕ	*play.*
mergō	mersī	mersum	mergĕrĕ	*sink* (tr.).
mittō	mīsī	missum	mittĕrĕ	*send.*
nectō	nexī *or* nexŭī	nexum	nectĕrĕ	*bind.*
ning(u)o	ninxī		ning(u)-ĕrĕ	*snow.*
nūbō	nupsī	nuptum	nūbĕrĕ	*to be married* (of a woman)
pectō	pexī	pexum *or* pectītum	pectĕrĕ	*comb.*
pingō	pinxī	pictum	pingĕrĕ	*paint.*
plaudō	plausī	plausum	plaudĕrĕ	*clap.*
prĕmō	pressī	pressum	prĕmĕrĕ	*squeeze.*
prōmō	prompsī	promptum	prōmĕrĕ	*bring out.*
quătĭō	quassī	quassum	quătĕrĕ	*shake.*
rādō	rāsī	rāsum	rādĕrĕ	*scrape.*
rĕgō	rexī	rectum	regĕrĕ	*rule.*
dīrĭgō	dīrexī	dīrectum	dīrĭgĕrĕ	*direct.*
pergō	perrexī	perrectum	pergĕrĕ	*proceed.*
surgō	surrexī	surrectum	surgĕrĕ	*rise.*
rēpō	repsī	reptum	rēpĕrĕ	*creep.*
rōdō	rōsī	rōsum	rōdĕrĕ	*gnaw.*
scalpō	scalpsī	scalptum	scalpĕrĕ	*scrape, carve.*
scribō	scripsī	scriptum	scrībĕrĕ	*write.*
spargō	sparsī	sparsum	spargĕrĕ	*scatter.*
aspergō	aspersī	aspersum	aspergĕrĕ	*sprinkle.*
stringō	strinxī	strictum	stringĕrĕ	*draw tight.*
strŭō	struxī	structum	strŭĕrĕ	*build.*
sūmō	sumpsī	sumptum	sūmĕrĕ	*take.*
temnō	tempsī	temptum	temnĕrĕ	*despise.*
ting(u)ō	tinxī	tinctum	ting(u)ĕrĕ	*dye.*
trăhō	traxi	tractum	trăhĕrĕ	*drag.*
invādō	invāsī	invāsum	invādĕrĕ	*attack.*
vĕhō	vexī	vectum	vĕhĕrĕ	*carry.*
vīvō	vixī	victum	vīvĕrĕ	*live.*

4. Perfect formed by adding **v**, preceded by a long vowel:

PRESENT.	PERFECT.	SUPINE.	INFINITIVE.	
căpessō	capessīvī	capessītum	capessĕrĕ	*undertake.*
cernō	crēvī	crētum	cernĕrĕ	*sift, distinguish.*
dēcernō	dēcrēvī	dēcrētum	dēcernĕrĕ	*decide.*
lăcessō	lacessīvī	lăcessītum	lăcessĕrĕ	*provoke.*
crescō	crēvī	crētum	crescĕrĕ	*grow* (intr.).
cŭpīō	cŭpīvī	cŭpītum	cŭpĕrĕ	*desire.*
quaerō	quaesīvī	quaesītum	quaerĕrĕ	*inquire.*
răpīō	rapuī	raptum	rapere	*snatch.*
săpīō	săpīvī *or* săpĭī		săpĕrĕ	*taste of.*
sĕrō	sēvī	sătum	sĕrĕrĕ	*sow.*
sĭnō	sīvī	sītum	sĭnĕrĕ	*allow.*
spernō	sprēvī	sprētum	sperněrĕ	*despise.*

Having inceptive forms in the Present:

PRESENT.	PERFECT.	SUPINE.	INFINITIVE.	
ădŏlescō	ădŏlēvī	ădultum	ădŏlescĕrĕ	*grow up.*
noscō	nōvī	nōtum	noscĕrĕ	*get to know.*
agnoscō	agnōvī	agnĭtum	agnoscĕrĕ	*recognise.*
cognoscō	cognōvī	cognĭtum	cognoscĕrĕ	*know.*
ignōscō	ignōvī	ignōtum	ignoscĕrĕ	*pardon.*

PRESENT.	PERFECT.	SUPINE.	INFINITIVE.	
obsŏ-lescō	obsŏlēvī	obsŏlētum	obsŏles-cĕrĕ	*grow old.*
pascō	pāvī	pastum	pascĕrĕ	*pasture.*
suescō	suēvī	suētum	suescĕrĕ	*become accustomed.*
quĭescō	quĭēvī	quĭētum	quĭescĕrĕ	*rest.*
pĕtō	pĕtīvī *or* pĕtĭī	pĕtītum	pĕtĕrĕ	*seek.*

5. Perfect formed by adding **u**:

PRESENT.	PERFECT.	SUPINE.	INFINITIVE.	
cŏ-ălescō	coaluī		coalescere	*grow together.*
ălō	ălŭī	altum *or* ălĭtum	ălĕrĕ	*nourish.*
cŏlō	cŏlŭī	cultum	cŏlĕrĕ	*cultivate.*
com-pescō	com-pescŭī		com-pescĕrĕ	*check.*
consŭlō	consŭlŭī	consultum	consŭlĕrĕ	*consult.*
occŭlō	occŭluī	occultum	occulere	*conceal.*
accumbō	accŭbŭī	accŭbĭtum	accumb-ĕrĕ	*recline* (at table).
incumbō	incŭbŭī	incŭbĭtum	incumbĕrĕ	*lean.*
frĕmō	frĕmŭī	fremĭtum	frĕmĕrĕ	*roar.*
gĕmō	gemŭī	gemĭtum	gĕmĕrĕ	*groan.*
gignō	gĕnŭī	genĭtum	gignĕrĕ	*produce.*
mĕtō	messuī	messum	mĕtĕrĕ	*reap, mow.*
mŏlō	molŭī	molĭtum	mŏlĕrĕ	*grind.*
occŭlō	occŭlŭī	occultum	occŭlĕrĕ	*hide.*
pinsō *or* pīsō	pinsŭī *or* pinsī	pinsum *or* pinsĭtum pistum	pinsĕrĕ	*pound.*
pōnō	pŏsŭī	pŏsĭtum	pōnĕrĕ	*put.*
praecĭnō	praecĭnŭī	praecen-tum	praecĭn-ĕrĕ	*sing before.*

So also other compounds of **cănō**, *sing.*

răpĭō	răpŭī	raptum	răpĕrĕ	*seize.*
abrĭpĭō	abrĭpŭī	abreptum	abrĭpĕrĕ	*carry off.*
sĕrō	serŭī	sertum	sĕrĕrĕ	*join.*
consĕrō	consĕrŭi	consertum	consĕrĕrĕ	*put together.*
strĕpō	strĕpŭī	strepitum	strĕpĕrĕ	*resound.*
texō	texŭī	textum	texĕrĕ	*weave.*
trĕmō	tremŭī		trĕmĕrĕ	*tremble.*
vŏmō	vŏmŭī	vŏmĭtum	vŏmĕrĕ	*vomit.*

6. Perfect stem the same as Present stem:

PRESENT.	PERFECT.	SUPINE.	INFINITIVE.	
ăcŭō	ăcŭī	ăcūtum	ăcŭĕrĕ	*sharpen.*
argŭō	argŭī	argūtum	argŭĕrĕ	*make clear, prove.*
bĭbō	bĭbī		bĭbĕrĕ	*drink.*
accendō	accendī	accensum	accendĕrĕ	*kindle.*
congrŭō	congrŭī	.	congrŭĕrĕ	*agree.*
dēfendō	dēfendī	dēfensum	dēfendĕrĕ	*ward off.*
dīlŭō	dīlŭī	dīlūtum	dīlŭĕrĕ	*wash away.*
excūdō	excūdi	excūsūm	excūdĕrĕ	*hammer out.*
făcessō	făcessī	făcessītum	făcessĕrĕ	*perform.*
findō	fĭdī	fissum	findĕrĕ	*cleave.*
imbŭō	imbŭī	imbūtum	imbŭĕrĕ	*steep.*
mandō	mandī	mansum	mandĕrĕ	*chew.*
mĭnŭō	minŭī	minūtum	minŭĕrĕ	*lessen.*

PRESENT.	PERFECT.	SUPINE.	INFINITIVE.	
abnŭō	abnŭī	abnutum	abnŭĕrĕ	*refuse.*
annŭō	annŭī	annūtum	annuere	*approve.*
expandō	expandī	expansum	expand-ĕrĕ	*spread out.*
prĕhendō	prĕhendī	prĕhensum	prĕhend-ĕrĕ	*seize.*
pollŭō	pollŭī	pollūtum	pollŭĕrĕ	*pollute.*
psallō	psallī		psallĕrĕ	*play the harp.*
rŭō	rŭī	rūtum	rŭĕrĕ	*fall.*
dīrŭō	dīrŭī	dīrūtum	dīrŭĕrĕ	*overthrow.*
ascendō	ascendī	ascensum	ascendĕrĕ	*ascend.*
descendō	descendī	descensum	descend-ĕrĕ	*descend.*
scindō	scĭdī	scissum	scindĕrĕ	*tear.*
sīdō	sīdī	sessum	sīdĕrĕ	*settle*(intr.).
consīdō	consēdī	consessum	consīdĕrĕ	*settle down*
solvō	solvī	sŏlūtum	solvĕrĕ	*loosen.*
spŭō	spŭī	spūtum	spŭĕrĕ	*spit.*
stătŭō	stătŭī	stătūtum	stătŭĕrĕ	*set up.*
constĭ-tŭō	constĭtŭī	constĭtū-tum	constĭtŭ-ĕrĕ	*settle.*
sternŭō	sternŭī	sternūtum	sternŭĕrĕ	*sneeze.*
strīdō	strīdī		strīdĕrĕ	*creak.*
sŭō	sŭī	sūtum	sŭĕrĕ	*sew.*
exŭō	exŭī	exūtum	exŭĕrĕ	*strip off.*
indŭō	indŭī	indūtum	indŭĕrĕ	*put on.*
vertō	vertī	versum	vertĕrĕ	*turn* (tr.).
volvō	volvī	vŏlūtum	volvĕrĕ	*roll* (tr.).

Deponent in Perfect:

PRESENT.	PERFECT.	SUPINE.	INFINITIVE.	
fīdō	fīsus sum	fīsum	fīdĕrĕ	*trust.*

Fourth Conjugation

1. Reduplicated Perfect: none.

2. Perfect formed by lengthening stem vowel:

PRESENT.	PERFECT.	SUPINE.	INFINITIVE.	
vĕnĭō	vēnī	ventum	vĕnīrĕ	*come.*

3. Perfect formed by adding **s**:

PRESENT.	PERFECT.	SUP INE.	INFINITIVE.	
farcĭō	farsī	fartum	farcīrĕ	*stuff.*
fulcĭō	fulsī	fultum	fulcīrĕ	*prop.*
haurĭō	hausī	haustum	haurīrĕ	*draw, drink.*
saepĭō	saepsī	saeptum	saepīrĕ	*enclose.*
sancĭō	sanxī	sanctum *or* sancitum	sancīrĕ	*ordain.*
sarcĭō	sarsī	sartum	sarcīrĕ	*patch.*
sentĭō	sensī	sensum	sentīrĕ	*feel.*
vincĭō	vinxī	vinctum	vincīrĕ	*bind.*

4. Perfect formed by adding **v**, preceded by a long vowel:

PRESENT.	PERFECT.	SUPINE.	INFINITIVE.	
sĕpĕlĭō	sĕpĕlīvī	sĕpultum	sĕpĕlīre	*bury.*

Sĕpĕlĭō is cited only on account of its irregular supine. This is the ordinary method of forming the perfect in this declension.

5. Perfect formed by adding **u**:

PRESENT.	PERFECT.	SUPINE.	INFINITIVE.	
ămĭcĭō	ămĭcŭī *or* ămixī	amictum	ămĭcīrĕ	*clothe.*
ăpĕrĭō	ăperŭī	ăpertum	ăpĕrīrĕ	*open.*
ŏpĕrĭō	ŏpĕrŭī	ŏpertum	ŏpĕrīrĕ	*cover.*
sălĭō	salŭī		sălīrĕ	*jump.*
dēsĭlĭō	dēsĭlŭī		dēsĭlīrĕ	*jump down.*

6. Perfect base the same as the Present base:

PRESENT.	PERFECT.	SUPINE.	INFINITIVE.	
com-pĕrĭō	compĕrī	comper-tum	compĕrīrĕ	*find out.*
rĕpĕrĭō	rĕpĕrī *or* reppĕrī	rĕpertum	rĕpĕrīrĕ	*find.*

Exercise 13

Translate into English:—

1. Omnes Samnitium copiae montes proximos fuga capiunt. 2. Patrium animum virtutemque capiamus. 3. Equidem pacem hortari non desino. 4. Intellexi ex tuis literis te ex Turannio audisse. 5. Intoleranda vis aestus omnium ferme corpora movit. 6. Fas est et ab hoste doceri.

Translate into Latin:—

1. Every one is the artificer of his own fortune. 2. Great is the power of habit. 3. The judge is condemned when the guilty man is acquitted. 4. I consider nothing human foreign to me. 5. Whom Jupiter desires to ruin he first makes insane. 6. They are able because they seem to be able (they can because they think they can).

E. A. B.

FRENCH.—XIV

Remarks on the Conjugations.—The attention of the student should be directed to some peculiarities in the regular conjugations, especially in the first and fourth. There is also the group of verbs in the second which has already been mentioned as almost forming a separate conjugation.

Let us take the first conjugation to begin with.

In verbs ending in **-ger** an **e** mute is inserted after the **g** before **a** or **o**, to show that the **g** retains its soft sound, thus:

Nous mangeons, *we eat.* Je mangeai, *I ate.* Jugeant, *judging.*

Similarly, in verbs ending in **-cer** a cedilla is put under the **c** before **a** or **o**, to show that the **c** retains its soft pronunciation, thus:

Nous plaçons, *we place.* Commençant, *beginning.*

In most verbs ending in **-eter** or **-eler** the **t** or **l** is doubled before an **e** mute, thus:

J'appelle, *I call;* ils appellent, *they call;* appeler, *to call.*

Je jetterai, *I will throw;* tu jettes, *thou throwest;* jeter, *to throw.*

The following are exceptions to this rule: **acheter**, *to buy*, **bourreler**, *to torment*, **colleter**, *to collar*, **congeler**, *to congeal*, **déceler**, *to detect*, **décolleter**, *to cut a garment so as to leave the throat bare*, **dégeler**, *to thaw*, **étiqueter**, *to ticket*, **geler**, *to freeze*, **harceler**, *to tease*, **peler**, *to peel*, and some others. In these a grave accent is put over the **e**, thus:

Je pèle, *I peel;* je pèlerai, *I shall peel;* peler, *to peel.*

J'achète, *I buy;* j'achèterai, *I shall buy;* acheter, *to buy.*

In other verbs with **e** mute in the last syllable of the stem a grave accent is put over the **e** before a syllable containing **e** mute, thus:

Semer, *to sow;* je sème, *I sow;* nous sèmerons, *we shall sow;* qu'ils sèment, *let them sow.*

Lever, *to raise;* tu lèves, *thou raisest;* il lèverait, *he would raise;* lève, *raise* (thou).

In the same way, verbs with **e** acute in the last syllable of the stem change it to **e** grave before a syllable containing **e** mute, except in the future and conditional, thus:

Céder, *to yield;* il cède, *he yields;* qu'ils cèdent, *let them yield;* je céderai, *I shall yield;* vous céderiez, *you would yield.*

Protéger, *to protect;* tu protèges, *thou protectest;* qu'ils protègent, *let them protect;* ils protégeraient, *they would protect.*

In verbs ending in **-oyer** or **-uyer** the **y** is changed to **i** before **e** mute, thus:

Employer, *to employ;* j'emploie, *I employ;* il emploiera, *he will employ.*

Essuyer, *to wipe;* il essuie, *he wipes;* j'essuierais, *I should wipe.*

Nettoyer, *to clean;* tu nettoies, *thou cleanest;* ils nettoient, *they clean.*

This rule applies to verbs in any of the four conjugations whose present participle ends in **-oyant** or **-ayant**.

In verbs ending in **-ayer**, **y** may be changed to **i** in the third person of the present indicative, and in the future and the conditional; but the **y** is retained elsewhere. Thus we may have **il paye** or **il paie**, **ils payent** or **ils paient**, **je payerai** or **je paierai.**

Verbs ending in **-eyer** retain the **y** throughout.

Note that in verbs ending in **-ier** the **i** is part of the stem, and consequently two **i**'s come together in certain cases, thus:

Prier, to *pray*; nous priions, *we pray*; vous priiez, *you pray*.
Etudier, *to study*; que nous étudiions, *that we may study*; que vous étudiiez, *that you may study*.

Similarly, verbs ending in **-éer**, as **créer**, have **je créerai**, **nous créions**, etc.

We turn now to the fourth conjugation. In verbs ending in **-andre**, **-endre**, **ondre**, the **d** in the third person singular present indicative is retained instead of the normal **t**, as in **vend**, *he sells*. **Apprendre**, *to learn*, is conjugated in the present indicative as follows :

j'apprends, *I learn.*	nous apprenons
tu apprends	vous apprenez
il apprend	ils apprennent

Verbs ending in **-aindre**, **-eindre**, **-oindre**, lose the **d** in the singular present indicative, having **t** in the third person, thus : **je crains**, *I fear*, **tu crains**, **il craint**.

These verbs change **nd** to **gn** before an ending beginning with a vowel, thus : **nous craignons**, *we fear*, **vous craignez**, **ils craignent**.

Verbs ending in **-aitre**, **-oitre** have the circumflex accent on the **i** when this is followed by **t** ; thus, **connaître**, *to know*, is conjugated in the present indicative as follows :

je connais, *I know.*	nous connaissons
tu connais	vous connaissez
il connaît	ils connaissent

The verb **plaire**, *to please*, and its derivatives **complaire** and **deplaire**, have the circumflex accent on the **i** in the third person singular present indicative, thus : **il plaît**, **il complaît**, **il deplaît**.

Verbs ending in **-uire** change the **r** to **s**, except in the future and conditional. **Conduire**, *to conduct*, is conjugated as follows :

je conduis, *I conduct.*	nous conduisons
tu conduis	vous conduisez
il conduit	ils conduisent
je conduisais (imperfect)	je conduisis (past def.)
je conduirai (future)	je conduirais (conditional)
conduis (imperative)	conduisant (pres. part.)
que je conduise (pres. subjunctive)	que je conduisisse (imperf. subjunctive)

Second Conjugation.—The group of verbs in the **-ir** conjugation, which is sometimes spoken of as an old conjugation (i.e. one in which new verbs are no longer formed), and sometimes simply classed with the irregular verbs, is conjugated according to the following model, in which you will observe that **-iss-** is not added to the stem in the present indicative or the present participle or the tenses formed therefrom :

Mentir, *to tell lies.*

Mentir, mentant, menti, je mens, je mentis.

Indicative Mood

PRESENT	IMPERFECT
je mens, *I lie.*	je mentais, *I lied.*
tu mens	tu mentais
il ment	il mentait
nous mentons	nous mentions
vous mentez	vous mentiez
ils mentent	ils mentaient
PAST DEFINITE	**FUTURE**
je mentis, *I lied.*	je mentirai, *I shall lie.*
tu mentis	tu mentiras
il mentit	il mentira
nous mentîmes	nous mentirons
vous mentîtes	vous mentirez
ils mentirent	ils mentiront

Conditional Mood

je mentirais, *I should lie.*	nous mentirions
tu mentirais	vous mentiriez
il mentirait	ils mentiraient

Imperative Mood

mens, *lie* (thou).	mentons
qu'il mente	mentez
	qu'ils mentent

Subjunctive Mood

PRESENT	IMPERFECT
que je mente, *that I may lie.*	que je mentisse, *that I might lie.*
que tu mentes	que tu mentisses
qu'il mente	qu'il mentît
que nous mentions	que nous mentissions
que vous mentiez	que vous mentissiez
qu'ils mentent	qu'ils mentissent

VOCABULARY

âîné, *elder.*	la fenêtre, *the window.*
alors, *then.*	juger, *to judge.*
à propos, *at the right moment, conveniently.*	le mari, *the husband.*
apparemment, *apparently.*	mourir, *to die.*
le banquier, *the banker.*	pendant, *during.*
la belle-sœur, *the sister-in-law.*	remercier, *to thank.*
le cœur, *the heart.*	des remercîments, *thanks.*
déjà, *already.*	la semaine, *the week.*
le déshonneur, *dishonour.*	le séjour, *the stay, sojourn.*
dès que, *as soon as.*	la sottise, *the mistake, blunder.*
échapper, *to escape.*	souffrir, *to suffer.*
l'erreur (f.), *error.*	suffire, *to suffice.*
	tard, *late.*

Exercise 25

1. Il craint de faire une sottise. 2. Apparemment cela suffisait. 3. Peut-être la reconnaîtrez-vous. 4. Il ne la reconnaît pas. 5. On connaît ce moment-là. 6. Il aperçoit votre intention. 7. Nous aperçûmes notre erreur. 8. Qu'il la reçoive dans son cœur.

9. Je l'ai aperçu tout de suite. 10. Vous le recevrez demain. 11. Nous le jugeâmes correctement. 12. Ils achetèrent de la viande, du pain, et du vin. 13. Recevez, monsieur, nos plus sincères remerciments. 14. Nous préférons mourir que souffrir le déshonneur. 15. Elle a aperçu son mari à la fenêtre. 16. Le banquier reçut-il beaucoup d'argent?

Exercise 26

1. Have your sisters written? 2. They have not yet written. 3. Have you brought us our clothes? 4. I am selling only one; I am keeping the other for my sister-in-law. 5. Do you receive any money to-day? 6. We do not receive much. 7. Does your carpenter finish his work early? He finishes it late. 8. At what time does he finish it? 9. He finishes it at half-past twelve. 10. We finish ours at twenty to ten. 11. When he gave you money yesterday, did you thank him? 12. I thanked him and begged him to thank you. 13. Have you found your books? 14. I have not found them yet. 15. When you came to see us, did you not finish your business with my father?

Key to Exercise 22

1. Auras-tu bientôt fini? 2. Est-ce bien vrai? dit Hélène. 3. Oh! ne doute pas de moi. 4. Laisse moi donc parler. 5. Je cherchais un appartement pour mon frère. 6. Elle vous laisse libre. 7. Elle ne lui laissa pas le temps de parler. 8. Chantez-vous une chanson italienne? 9. Nous chantons une chanson anglaise. 10. Portez-vous ce livre à l'homme? 11. Non, je le porte à mon frère. 12. Emportez-vous tout votre argent? 13. J'en emporte seulement une partie. 14. Finissez-vous votre leçon aujourd'hui? 15. Nous la finissons ce matin. 16. N'aimez-vous pas les enfants attentifs? 17. Je les aime beaucoup. 18. Votre mère aime-t-elle la lecture? 19. Oui, mademoiselle, elle l'aime beaucoup plus que sa sœur. 20. Quel chapeau votre cousin porte-t-il? 21. Il porte un chapeau de soie, et je porte un chapeau de paille.

Key to Exercise 23

1. He recognised her at once; it was she. 2. He perceived before him a woman who walked slowly. 3. I followed this lady as far as the Arc de Triomphe. 4. She turned to the left to enter the Rue de Rivoli. 5. Then she turned to the right to the Rue des Saints-Pères. 6. It appears that she does not live quite near me. 7. I do not like it; show me another. 8. He looked for her from street to street. 9. She was well hidden in the immense city. 10. There was no need for him to seek her long. 11. He determined to write his poem in elevated style. 12. The story was modified a little by the poet. 13. As soon as the poem was written, Jules took it to the newspaper. 14. All the precautions are properly taken. 15. What will you say to justify yourself?

Key to Exercise 24

1. Ne recevez-vous pas beaucoup de lettres? 2. Nous en recevons beaucoup. 3. Vendez-vous beaucoup de marchandises? 4. Nous en vendons beaucoup. 5. Votre frère aime-t-il le bœuf et le mouton? 6. Cette dame aime-t-elle ses enfants? 7. Oui, monsieur, elle les chérit. 8. Fournissez-vous des marchandises à ces marchands? 9. Je fournis des marchandises à ces marchands, et ils me donnent de l'argent. 10. Vos compagnons aiment-ils les beaux habits? 11. Nos compagnons aiment les beaux habits et les bons livres. 12. Cherchez-vous votre frère? 13. Oui, monsieur, je le cherche, mais je ne le trouve pas. 14. Votre frère perd-il son temps? 15. Il perd son temps et son argent. E. A. B.

GERMAN.—XI

Use of the Articles.—The articles are used much the same in German as in English, but there are certain differences which we shall now note.

The def. art. is regularly used in German before nouns used in their widest sense and standing for a whole class—Ich liebe die Blumen, *I love flowers;* das Gold iſt ein wertvolles Metall, *gold is a valuable metal.* Hence it is used before abstract nouns, since these are most frequently used in a general sense; but when they are used in a particular sense, e.g. when preceded by a preposition, the def. art. is not used—die Leidenſchaft flieht, die Liebe muß bleiben, *passion flees, love must remain;* but ſie ſprach mit Leidenſchaft, *she spoke passionately* (i.e. with passion).

It is often used when we use a poss. adj. in English. This is the case when the possessor is clearly indicated by the context, i.e. when the possessor is either the subject of the verb or is represented by a noun or pronoun in the dat. case—Ich ſchüttelte den Kopf, *I shook my head;* das gab ihm einen Stich ins (in das) Herz, *that stabbed his heart* (gave him a stab in the heart).

It is placed before certain classes of words which take no art. in English:

(*a*) Names of months, seasons, and days of the week—Der Mai iſt ein ſchöner Monat, *May is a lovely month;* der Sommer fängt dieſes Jahr ſpät an, *summer begins late this year;* das geſchah am Freitag, *that happened on Friday.*

(*b*) Names of streets, mountains, and the names of countries which are feminine—Er wohnt in der Friedrichſtraße, *he lives in Frederick Street;* der Brocken iſt der höchſte Berg im Harzgebirge, *Brocken is the highest mountain in the Harz Mountains;* wir reiſen nach der Schweiz, *we are travelling to Switzerland.*

(*c*) It is often placed before proper names, and practically always when these are preceded by an adjective—Haben Sie den Heinrich irgendwo geſehen? *Have you seen Henry anywhere?* Die arme Luiſe iſt krank, *poor Louise is ill.*

Further, the def. art. is used in German where we use the indef. art. in English in a distributive sense—dieſes Fleiſch koſtet eine Mark das Pfund, *this meat costs one mark a pound;* wir gehen Morgens früh aus, *we go out early of a morning* (in the morning); er kommt dreimal die Woche, *he comes three times a week.*

The indef. art. is usually omitted in

German before a noun used predicatively after ſein or werden and after als (as) introducing a noun in apposition—Mein Bruder iſt Offizier und mein Vetter wird Kaufmann, *my brother is an officer and my cousin is going to be a merchant;* ich kann ihn als Sänger nicht leiden, *I do not like* (cannot suffer) *him as a singer.*

The above are the main differences in the use of the articles in German and English. Such further differences as occur should be noted by the student when he meets with them.

The def. art. precedes all other qualifying words except all, *all.* Die mit koſtbaren Teppichen behängten Wände, *the walls hung with valuable rugs;* but alle die Könige der Welt, *all the kings of the world.*

The indef. art. also precedes other qualifying words, but it follows welch, *what,* and was für, *what sort of.* It may either precede or follow ſolch or ſo, *such;* in the former case ſolch is declined like any other adjective, unless it is used adverbially—ſo ein ſchönes Pferd, or ſolch ein ſchönes Pferd, ein ſo ſchönes Pferd, or ein ſolch ſchönes Pferd, are four different ways of rendering, in German, *such a beautiful horse.* So ein Mann, ſolch ein Mann or ein ſolcher Mann all mean *such a man.* In the first two examples ſo and ſolch are used adverbially; in the second two they are used adjectivally—Welch ein unglück! *What a misfortune!* was für ein Buch iſt das? *What sort of a book* (or what book) *is that?*

Pronouns.—Uses of the neuter pers. pron.:

Es is used as the subject of impersonal verbs, as in English—Es regnet, *it rains;* es iſt der Arzt, *it is the doctor.* But in such phrases as *it is I, it is he,* in which the complement of the verb to be is a pers. pron., the order in German is reversed; the above would be ich bin es, er iſt es.

Es often corresponds to our use of *there*—Es war nichts darin, *there was nothing in it.*

Often, too, es is used as a temporary grammatical subject, and the logical subject is then placed after the verb. This is frequently done even in cases when we should not use a temporary grammatical subject in English—Es iſt viel beſſer ſolche Sachen zu vermeiden, *it is much better to avoid such things;* here in both languages the logical subject of the verb is the infinitive phrase ſolche Sachen zu vermeiden, *to avoid such things.* Es blaſen die Trompeten, *the trumpets blow;* here in English we place the subject before the verb.

The student will note that in all these cases the verb agrees in number with the logical subject.

When governed by a preposition the dat. and acc. of the neut. pron. is rarely used. Instead the adverb da (dar before a vowel) is prefixed to the prep.—damit, darin, dafür, darum stand for mit ihm, in ihm, für es, um es, and so on. This construction is exactly like the English *therewith, thereby,* etc.

We have already dealt with the reflexive pronouns. The student will remember that only the third pers. pron. has a special form for the reflexive, namely, ſich (dat. and acc. m.f.n. sing. and plur.). He is also reminded that the reciprocal pronouns are the same as the reflexive.

When the forms *myself, himself,* etc., are used emphatically and not reflexively they are rendered in German by ſelbſt or ſelber, *self*—Ich ſelbſt (or ſelber) habe es getan, *I myself did it;* Ich habe mir ſelber nur geſchadet, *I injured only myself.*

Demonstratives.—Derjenige is often used for the demons. der as the antecedent of an adjectival clause. This is the case both when used adjectivally and pronominally—Diejenigen Menſchen (or diejenigen) welche immer unzufrieden ſind haben wenige Freunde, *those people* (or they) *who are always dissatisfied have few friends.*

Both der (demons.) and derſelbe are used to avoid ambiguity—Ich beſuchte meinen Freund und deſſen Bruder, *I visited my friend and his brother.* If we had said ſeinen Bruder, this might have referred to the brother of some third person; deſſen can only refer to Freund. The same sentence might have been rendered—Ich beſuchte meinen Freund und den Bruder desſelben, *I visited my friend and the brother of the same.*

Derſelbe is also used to avoid awkward repetitions—Ich ſah vorgeſtern Herrn und Frau Meyer; kennen Sie dieſelben? instead of kennen Sie ſie? *I saw Mr. and Mrs. Meyer; do you know them?*

In the gen. and dat. cases when referring to things and not persons. Entſinnen ſie ſich des Wortlauts ſeines Briefes? Ja ich entſinne mich deſſen. *Do you remember the wording of his letter? Yes, I remember it;* ſeines would refer to him and not to the wording.

Interrogatives.—The antiquated form of the genitive weß is used only in compounds such as weswegen, *for what reason, why.*

It was pointed out before that the neut. interrog. was has no dative form; when

governed by a preposition the adverb wo (wor before vowels) is used in its place—wofür, *for what?* worin, *wherein* or *in what?* etc.

Compounds of the adverbs da and hier with prepositions are used for various cases of the different demons. pronouns, governed by the prepositions—Hiermit, *with this*, damit, *with that*, hierin, *in this*, darin, *in that*.

Welch when used before ein or an adj. is usually invariable—Welch eine Idee! *what an idea!* Welch ſchöne Kinder! *What lovely children!*

Was für in the sense of *what kind of* is always invariable, and the words which follow it have the same construction as if the words was für were omitted from the sentence—Mit was für Mitteln erzielen Sie dies? *With what* (kind of) *means do you attain this?*

Was für is also used in an exclamatory sense, in which case it means *what*—Was für ein ſchöner Tag! *What a fine day!*

Was need not be immediately followed by für—Was iſt er für ein begabter Menſch! *What a gifted man he is!*

Idiomatic Uses of gern.—Gern or gerne is really an adverb meaning *willingly, readily, gladly*. In conjunction with verbs it is used in the sense of liking to do a thing—Ich reite gern, *I like riding*. It is even used somewhat unnecessarily with the verb mögen, *to like*. Er mag gern leſen, *he likes reading*.

Gern haben means *to like, to be fond of*—Sie hat mich recht gern, *she likes me very much* or *she is very fond of me*.

Gern can be used with the negative nicht, or else ungern can be used, un being a negative prefix—Ich habe es nicht gern getan, *I did not do it willingly;* Ich habe es ungern getan, *I did it unwillingly;* Ich möchte eben ſo gern zu Hauſe bleiben, *I would just as soon stay at home;* Wenn er auch noch ſo gern wollte, *however much he would like to;* Es iſt gern geſchehen, *you are very welcome* (it was willingly done); Herzlich gern, *with all my heart*.

For the comparative and superlative lieber and am liebſten are used—Wir bleiben lieber zu Hauſe, *we prefer to stay at home;* Am liebſten gehe ich ins Theater, *I best like to go to the theatre*.

VOCABULARY

Schloß, s.n.3, *castle*.
roſig, *rosy*.
Wolke, w.f., *cloud*.
niederneigen, w., *to bow down*.
Flut, w.f., *flood, water*.
ſtreben, w., *to strive, aspire*.
Glut, w.f., *glow*.
Mond, s.m.2, *moon*.
weit, *far*.
Wind, s.m.2, *wind*.
wehen, w., *to blow*.
her, *hither*.
ſpiegelklar, Spiegel, s.m.1, *mirror*, klar, *clear*.
ſteigen, s.3b, *climb, rise*.
wohl, *well, indeed*.
Nebel, s.m.1, *mist, fog*.
umher, *round about*.
Wallen, s.n.1, *flow, undulation*.
friſch, *fresh*.
vernehmen, s.1c, *to hear*.
Saite, w.f., *string, chord*.
Woge, w.f., *wave*.
tief, *deep*.
Klagelied, s.n.3, *song of lament*.
Träne, w.f., *tear*.
rot, *red*.
Strahl, w.m., *gleam, ray*.
herrlich, *glorious*.
Eltern, *parents*.
ſchwarz, *black*.
Meer, s.n.2, *sea*.
Klang, s.m.2, *sound*.
Halle, w.f., *hall*.
Feſtgeſang, s.n.2, *festal song*.
liegen, s.1,4d, *to lie*.
Ruhe, s.f., *peace, quiet*.
zuhören, w., *to listen to*.
Gemahl, s.n.2, *spouse*.
Krone, w.f., *crown*.
führen, w., *to lead*.
ſtrahlen, w., *to gleam*.
Licht, s.n.3, *light*.
Trauerkleid, s.n.3, *mourning garment*.

Exercise 29

Das Schloß am[1] Meere[2].

„Haſt du das Schloß geſehen,
Das hohe Schloß am Meer?
Golden[3] und roſig wehen
Die Wolken d'rüber[4] her[8].

Es möchte[5] ſich nieder neigen
In die ſpiegelklare[6] Flut;
Es möchte ſtreben und ſteigen
In der Abendwolken Glut."

„Wohl hab' ich es geſehen,
Das hohe Schloß am Meer,
Und den Mond darüber ſtehen[7]
Und Nebel weit umher[8]."

„Der Wind und des Meeres Wallen[9]
Gaben ſie friſchen Klang?
Vernahmſt du aus den Hallen
Saiten[10] und Feſtgeſang?"

Ludwig Uhland.

NOTES:—

(1) am (an dem)—here an has the meaning of *by*. The use of prepositions varies greatly in all languages, and can only be learnt by experience. (2) Meere—the fuller form of the dat. (3) golden, roſig—these adjectives are used adverbially here, but it sounds better in the English to translate them by adjectives used attributively to clouds. (4) d'rüber, darüber—the a is elided on account of the metre. (5) möchte—the past conjunctive of this verb is often used to express desire. (6) ſpiegelklar, a compound adj., *mirror clear;* it is similar in form to such English expressions as *sky blue, rose red*. (7) ſtehen—this infinitive depends on ſehen and is exactly equivalent to the English *to see a thing stand, to see a man run*, etc. (8) her—this is always used of motion towards the speaker; whereas motion away from the speaker is denoted by hin. (9) Wallen—this is an infinitive used as a noun. (10) Saiten—here the strings themselves are used in a figure of speech common to all poetry for the musical sounds emitted by them.

VOCABULARY

Emperor, Kaiſer, s.m.1.
Suite, Gefolge, s.n.1.
Whether, ob.
Prince, Fürſt, w.m.
Satisfy, befriedigen, w.
Answer, Antwort, w.f.
Excuse, Ausrede, w.f.
Guest, Gaſt, s.m.2.
Shave, raſieren, w.
Serve, dienen, w. gov. dat.
Way, Weiſe, w.f.
Before, vor.
Hostess, Wirtin, w.f.
Servant, Diener, s.m.1.
Curiosity, Neugier, w.f.
By, durch.
Make use of, benutzen, w.
Room, Zimmer, s.n.1.
Just, gerade.
When, als.
Some, irgend welch.
Sometimes, manchmal.

Exercise 30

The Emperor Joseph II. once (1) arrived (2) in a town before his suite, and his hostess, who did not know (3) him, asked whether (4) he was one of the emperor's servants. "No," replied the prince. But the good woman's curiosity (5) was not satisfied by this short answer, and she made use of an excuse to go (6) into her guest's room. He was (7) just (8) shaving (7) when she came into the room, and she asked him whether he did not serve the emperor in some way. (9) "Yes," said Joseph, "I sometimes (10) shave him."

NOTES:—

(1) *Once*—this adverb of time and the adverbial phrase of time before *his suite* must both be placed immediately after the finite verb and before the adverbial phrase of place, *in a town*. (2) *Arrived*—remember that ankommen is a separable verb, and that in a principal clause the separable prefix is placed at the end. (3) *Know* here used in the sense of *acquainted with*, therefore kennen. (4) *Whether . . .* this being a dependent question, the verb must be in the conjunctive mood. (5) Translate *the curiosity of the good woman*. (6) *To go*, um followed by the infinitive, which must, as usual, be placed at the end of the clause. (7) *Was shaving*, preterite tense; rasieren, is a trans. verb and therefore is used reflexively to translate the intrans. use of *shave*. (8) *Just*—the adverb of time is placed after the object when that object is a pronoun. (9) *In some way*—translate *in* by auf followed by the acc. (10) *Sometimes*, *see* (8).

The student should be careful to place the finite verb at the end of all dependent clauses.

Key to Exercise 27

I arrived in Berlin between five and six o'clock and drove immediately to a small hotel which had been recommended to me. There I got a comfortable bedroom with a good bed. I spent only a few days in Berlin, for I had to travel further soon in order to visit other German towns before my short leave (holiday) came to an end. I visited various museums and picture galleries, heard two very fine concerts, went to the theatre three or four times, where I enjoyed myself extraordinarily, and (was present at) attended a splendid performance at the Royal Opera House. What struck me most as a stranger was the life at night in Berlin; until three or four o'clock in the morning the cafés and beer houses are full of people, and the streets in the middle of the town are nearly as lively as in the daytime. But other towns in Germany pleased me much better than Berlin, some because they are more beautiful and some because they are older.

Key to Exercise 28

1. Sie kamen um drei Uhr am Donnerſtag den neunten Juli, 1899, in London an. 2. Ich reiſe oft nach London aber ſie waren ſeit zehn Jahren nicht dort geweſen. 3. Die vielen neuen Hotels und Cafés fielen ihnen am meiſten auf; ſie amüſierten ſich ſehr gut während des Monats den ſie in London zubrachten. 4. Die Theater und Konzerte gefielen ihnen ſehr, aber ſie möchten nicht in einer großen Stadt leben, denn ſie lieben das Leben in einer kleinen Stadt. 5. Die Straßen in London ſind ſo ſehr belebt und da iſt ſo viel Lärm. 6. Sie ſagten aber daß ihre Schlafzimmer in dem Hotel ruhig waren und die Betten ſo gut daß ſie gut ſchliefen und ſie amüſierten ſich im Ganzen gut.

M.A.L.

RUSSIAN.—IV

The Noun

N.B.—THE student is recommended to study carefully the rules and examples of pronunciation given hitherto, as henceforth the pronunciation will only be shown for the Vocabulary preceding the Exercises in each lesson.

Dative of Singular

15. The endings of this case are as follows:

For Masculine у, ю, ю, instead of the Nominative endings ъ, й, ь.
For Feminine ѣ, ѣ, и, instead of the Nominative endings а, я, ь.
For Neuter у, ю, instead of the Nominative endings о, е.

(See Rule 1)

Examples:

Фабрика́нту, *to the manufacturer.*	Ве́кселю, *to the bill.*
Това́ру, *to the goods.*	Фи́рмѣ, *to the firm.*
Казначе́ю, *to the treasurer.*	Торго́влѣ, *to the business.*
Сара́ю, *to the stable.*	При́были, *to the profit.*
Покупа́телю, *to the customer.*	Сло́ву, *to the word.*
	По́лю, *to the field.*

The Letter і

16. This letter does not suffer the letter ѣ after it, and transforms it into и. Therefore such feminine nominatives as ли́нія, *a line*, or па́ртія, *a party*, will become in the Singular Dative case ли́ніи, то *a line*, па́ртіи, то *a party*, i.e. with и at the end instead of ѣ.

Use of the Dative Case

17. The Dative denotes the object to which something is given, addressed, attributed, applied, or caused. While in English the Dative usually has the preposition "to" before it, it often dispenses with the preposition in Russian.

Examples:

Ущёрбъ дѣлу, *a loss* (detrimental) *to the business.*
Подо́бно образцу́, *similar to pattern.*

Verbs ruling the Dative

18. The following are the principal verbs requiring the Dative after them:

Обѣща́ть, *to promise.*	Вреди́ть, *to injure, cause damage, be detrimental.*
Вѣрить, *to believe, trust.*	Льсти́ть, *to flatter.*
Довѣря́ть, *to trust, to confide in.*	Мѣша́ть, *to disturb, interfere with.*
Помога́ть, *to help, assist, aid.*	Препя́тствовать, *to hinder, obstruct, prevent.*

Adverbs governing the Dative

19. The following are the main adverbs demanding the Dative after them:

Согла́сно, *in accordance with, according to.*
подо́бно, *similar.*

The Preposition "къ" or "ко"

20. This preposition, signifying "to," always requires the Dative, and no other, case after it.

Preposition "по"

21. This preposition requires the Dative after it on the following occasions:

(*a*) When it denotes the surface on which something moves.

Examples: По землѣ́, *on* or *over the earth.*
По мо́рю, *on the sea.*
По го́роду, *through the town.*

(*b*) When it denotes the mark or sign by which something is recognised, discerned, or judged.

Examples: По лицу́, *by the face.*
По цвѣ́ту, *by the colour.*
По разгово́ру, *by the speech.*

(*c*) When the cause or origin of some result is given.

Examples: По оши́бкѣ, *by mistake.*
По боле́зни, *through illness.*

(*d*) When referring to a ground, principle, source, etc.

Examples: По зако́ну, *according to law.*
По мнѣ́нію, *in the opinion of . . .*

(*e*) When equivalents of sums or numbers are spoken of.

Examples: По рублю́, *a rouble each.*
По копе́йкѣ, *a copeck each.*

Dative ending as Genitive

22. The Dative ending is given to the Genitive Singular of Masculine nouns when a part of a whole is spoken of.

Examples:

Мно́го наро́ду, *many people.*
Ма́ло това́ру, *a small quantity of goods.*
Фунтъ са́хару, *a pound of sugar.*
Ча́шка ча́ю, *a cup of tea.*
Пли́тка шокола́ду, *a tablet* (cake) *of chocolate.*

Practice XII

Decline the following Nominatives in consecutive order of Genitive, Dative, and Accusative:

Господи́нъ, *the master, gentleman, Mr., sir.*
Чай, *tea.*
Копія, *the copy.*
Арте́ль (f.), *a workman's union.*
Иде́я, *the idea.*
Служи́тель (m.), *the employee.*
Кора́бль (m.), *the ship, boat.*
Бога́тство, *richness, wealth.*
Сча́стье, *a mercy, good luck.*
Би́ржа, *the exchange.*

The Verb

Second or "и" Conjugation

23. The main feature of this conjugation is that it ends in the second Singular with **ишь**, and in the 3rd Plural with **ятъ**, as exemplified below:

Infinitive: Говори́ть, *to speak*

Sing.	*Plur.*
1. Я говорю́, *I speak.*	1. Мы говори́мъ, *we speak.*
2. Ты говори́шь, *thou speakest.*	2. Вы говори́те, *you speak.*
3. Онъ говори́тъ, *he speaks.*	3. Они́ говоря́тъ (m.), *they speak.*
3. Она́ говори́тъ, *she speaks.*	3. Они́ говоря́тъ (f.), *they speak.*
3. Оно́ говори́тъ, *it speaks.*	3. Они́ говоря́тъ (n.), *they speak.*

The Second Conjugation with a Labial Letter

24. When the Infinite ending -ить is preceded by any of the letters б, в, м, п, or ф, which, according to the laws of permutation, do not allow after them the vowel **ю**, the letter **л** must then be inserted in the first person Singular, for the sake of euphony between the above letters and the ending **-ю.**

Examples:

Infinitive	*Sing. First Person*
Люби́ть, *to like, love.*	Я люб**лю́**, *I like.*
Лови́ть, *to catch.*	Я лов**лю́**, *I catch.*
Клейми́ть, *to stamp.*	Я клейм**лю́**, *I stamp.*
Торопи́ть, *to hurry.*	Я тороп**лю́**, *I am hurrying.*
Торопи́ться, *to be in a hurry.*	я тороп**лю́сь**, *I am in a hurry.*
Гра́фить, *to draw lines.*	Я гра́ф**лю**, *I draw lines.*

Practice XIII

Conjugate the following:

Кури́ть, *to smoke.*
Хвали́ть, *to praise.*
Вѣ́рить, *to believe, trust.*
Мѣ́рить, *to measure.*
Дѣли́ть, *to divide.*
Губи́ть, *to ruin, lose.*
Ста́вить, *to set, put.*
Кои́мить, *to hem, border.*
Копи́ть, *to heap, save, amass.*
Тра́фить, *to hit an object, a target.*

VOCABULARY

Познава́ть,	(pa-zna-vát'),	*to recognise, judge.*
Досто́инство,	(da-stó-in-stvo),	*the value, quality.*
Осяза́ніе,	(a-sya-zá-ni-ye),	*the feel, touch.*
Ча́сто,	(chás-to),	*often.*
Наро́дъ,	(na-ród),	*people.*

Да,	(dah),	*yes.*
Чи́стосерде́чіе,	(chi-sto-ser-dyé-chi-ye),	*frankness, candour.*
Наставле́ніе,	(na-stav-lyé-ni-ye),	*instruction.*
Дире́кторъ,	(di-rék-tor),	*director.*
Но́вому,	(adjectiv.), (nó-vo-mu),	*to the new.*
А́дресъ,	(ád-ress),	*address.*
Уже́,	(u-zhé),	*already.*
Пла́вно,	(pláv-no),	*fluently.*
Тре́бованіе,	(tré-bo-va-ni-ye),	*the demand, will.*
Паковáть,	(pa-ko-vát'),	*to pack.*
Тща́тельно,	(tshchá-tyel-no),	*carefully.*
Небре́жность,	(nye-brézh-nost'),	*carelessness.*
Пако́вщикъ,	(pa-kóf-shchik),	*packer.*
Теря́ться,	(tye-ryát'-sya),	*to get lost.*
Путь,	(put'),	*the road, way.*
Мѣсто,	(myé-sto),	*the place.*
Назначе́ніе,	(na-zna-ché-ni-ye),	*destination.*
Отсыла́ть,	(at-sü-lat'),	*to send off.*
Покупа́тельница	(pa-ku-pá-tyel-ni-tsa),	*the lady customer.*
Посы́лка,	(pa-sül'-ka),	*the parcel.*
По́чта,	(po'-chta),	*the post.*
Ка́ждому,	(dat., m., adj.), (kázh-do-mu),	*each.*
Разска́зъ,	(ras-káz),	*tale, report.*
Разска́зывать,	(ras-ka-zü-vat'),	*to tell a tale.*
Францу́зскій,	(fran-tsús-ki),	*the French.*
Ка́чество,	(ká-che-stvo),	*the quality.*
Благодари́ть,	(bla-ga-da-rit'),	*to thank.*
Аккура́тное,	(ak-ku-rát-no-ye),	*accurate.*
Выполне́ніе,	(vü-pal-nyé-ni-ye),	*execution* (of orders), *accomplishment.*
Пра́вда,	(práv-da),	*true, the truth.*
Стро́ить,	(stró-it'),	*to build.*
Домъ,	(dom),	*house.*
Нѣтъ,	(nyet),	*no.*
Непра́вда,	(nye-práv-da),	*a lie, untruth.*
Перестра́ивать,	(pere-strá-i-vat'),	*to rebuild.*
Фа́брика,	(fá-bri-ka),	*the factory.*
Куда́,	(ku-dá),	*where to, whither.*
Вокза́лъ,	(va-kzál),	*railway station.*
Нра́виться,	(with Dative) (nrá-vit'-sya),	*to like.* *
Конто́ра,	(kan-tó-ra),	*the office.*
Интере́сно,	(in-tye-rés-no),	*interesting to . . .*
Зараба́тывать,	(za-ra-bá-tü-vat'),	*to earn.*
Де́негъ,	(dyé-nyekh, gutural),	*any money.*
Папиро́ска,	(pa-pi-rós-ka),	*a cigarette.*
Вопро́съ,	(va-prós),	*a question.*
Бо́льше,	(ból'-she),	*more.*
Ко́фе,	(kó-fe),	*coffee.*
И́ли,	(í-li),	*or.*
Посыла́ть,	(pa-sü-lát'),	*to send.*
Ва́шему,	(vá-she-mu),	*to your.*
Ему́,	(pronoun, Dative) (ye-mú),	*him, to him.*
Иногда́,	(i-na-gdá),	*sometimes.*
Телегра́фъ,	(tye-lye-graff),	*telegraph.*
Домо́й,	(da-mój),	*home, homewards.*
По́здно,	(pózd-no),	*it is late.*

Exercise 5

Translate into English the following:

1. Я познаю́ досто́инство това́ра по осязáнію.
2. Мы о́чень ча́сто путеше́ствуемъ по Россіи.
3. Лю́бите ли Вы ру́сскій наро́дъ?
4. Да, я его́ о́чень люблю́ за его́ чи́стосерде́чіе.

* Literally, to be pleasing to . . :

5. По наставле́нію дире́ктора корреспонде́нтъ направля́етъ письмó къ аге́нту по его́ но́вому а́дресу.
6. Говори́те ли Вы уже́ пла́вно по-русски?
7. Согла́сно тре́бованію покупа́теля мы паку́емъ его́ това́ръ о́чень тща́тельно.
8. По небре́жности пако́вщика о́чень ча́сто теря́ется мно́го това́ру по пути́ къ мѣсту назначе́нія.
9. Я отсыла́ю покупа́тельницѣ посы́лку по по́чтѣ.
10. Я вѣрю ка́ждому сло́ву изъ его́ разска́за.
11. Что Вы говори́те?
12. Что Вы мнѣ тамъ разсказка́зываете?
13. Францу́зскій кліе́нтъ о́чень хва́литъ ка́чество на́шего това́ра, и благодари́тъ насъ за аккура́тное выполне́ніе его́ зака́за
14. Пра́вда ли что ты стро́ишь но́вый домъ?
15. Нѣтъ, э́то непра́вда. Я не стрóю дóма, но перестра́иваю фа́брику.
16. Куда́ Вы торо́питесь?
17. Я тороплю́сь на вокза́лъ.
18. Какъ Вамъ нра́вится моя́ конто́ра?
19. Мнѣ интере́сно знать, нра́влюсь ли я хозя́ину?
20. Я зараба́тываю мно́го, но не коплю́ де́негъ.

Exercise 6

Translate the following into Russian:

1. Do you smoke a cigarette?
2. Yes, I smoke very much.
3. Do you speak English fluently?
4. I do not speak much English.
5. Why do you put this question?
6. I put no question.
7. What do you prefer (like more), coffee or tea?
8. I like tea more.
9. How do you send your agent money?
10. I send him money per post, and sometimes by telegraph.
11. Why are you in such (такъ) a hurry?
12. I am hurrying home, because it is already late.
13. Does the Russian buyer praise our goods?
14. Yes, he approves (одобря́ть) of the quality (ка́чество) of our goods (това́ръ).
15. How do you recognise the value of goods?
16. We recognise the value (досто́инство) of the goods by the feel.
17. How do you like (нра́вится Вамъ) our business (торго́вля)?
18. I am pleased (it pleases me=мнѣ нра́вится) with it very much.
19. Do you stamp the goods (клейми́ть това́ръ)?
20. Yes, Mr. B. (господи́нъ Б.), I stamp the goods.

Conversations	Разговоры	
1. Какова́ пого́да?	(kakavá pagóda?),	*how is the weather?*
2. Стои́тъ прекра́сная пого́да.	(stai't prekrásnaya pagóda),	*it is beautiful weather.*
3. Ка́паетъ немно́жко.	(kápayet nyemnóshko),	*it is a bit drizzling.*
4. На дворѣ́ о́чень я́сно.	(na dvaryé óchen yásno),	*it is very bright outside.*
5. У́тромъ было тума́нно.	(útrom bü'lo tumánno),	*it was foggy this morning.*
6. Быть дождю́.	(büt' dazhdyú),	*it is going to rain.*
7. Снѣгъ па́даетъ.	(snyekh (guttural) pádayet),	*it snows.*
8. Слизко.	(sli'sko),	*it is slippery.*

A. C.

Continued from page 295.

GEOGRAPHY:

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COMMERCIAL VEGETATION PRODUCTS OF THE WORLD

It will be interesting before we close our general survey of the plant life of the globe to give a short description of a few of the most important plants which are of the greatest value to civilised man. For this purpose we will divide the vegetable products of the globe into three groups: those that are grown in (*a*) temperate, (*b*) subtropical, and (*c*) tropical countries.

Wheat is possibly the most important of all the cereals. This, though well known from the remotest ages in the Old World, was introduced into America since the time of Columbus, but at the present time the cultivation there has so greatly increased that Europe actually makes up her own deficiency by importing it in immense quantities from the United States, Canada, the Argentine, etc.

Wheat culture requires a higher temperature than oats, barley, or rye, but will grow in higher latitudes than maize. It is sown and the young plant grows in the winter, the grain ripening in the summer. "The ideal climate is one with a long and rather wet winter, with but little or no frost, prolonged into a cool and rather wet spring, which gradually fades into a warmer summer, the weather gradually growing drier as it gets warmer."

Wheat Growing

There are many varieties of wheat, and it is grown all over Europe, India, the United States of America, Canada, the Argentine Republic, Australia, and New Zealand. The yield per acre is highest in Great Britain, being some 30 bushels. In Russia and Australia it is sometimes as low as 8 bushels to the acre; this low output is due to scanty rainfall as in Australia, or in Russia to poor methods of cultivation.

Maize is the only cereal which was introduced from the New World into the Old. It is grown largely in the U.S.A. and in Canada. In Europe there is a considerable cultivation of this cereal in Roumania. It is not used much as a food in Great Britain, but on the continent is eaten in various forms. In the U.S.A. the green ears of maize are esteemed as a great delicacy.

Oats are grown chiefly in the more northerly and moister districts of Europe, but they are also grown in Canada and New Zealand. It is used as a food in the form of oat-cakes and porridge, but is mostly grown as forage for horses.

Fruits and Cereals

Barley has a very wide distribution of cultivation, and is nowadays chiefly used in the brewing of beer and the manufacture of whisky.

Rye is cultivated very largely in the countries of Europe as a bread food. It flourishes on very poor soils, and in very bad climates. Russia, North Germany, Switzerland, Austria, and southern Norway and Sweden are the chief countries where it is grown. It is practically unused in Great Britain. Potatoes were introduced from the New World, and are largely cultivated in Germany (where they form more than half the food of the working classes), and in Ireland. It is unfortunately liable to certain diseases, and where, as in Ireland, it is the staple food of the inhabitants, this may lead, as has been too frequently the case, to famines and great consequent distress.

Among the fruits of the temperate climates we may mention oranges. These are believed to have been introduced from China. Spain, Italy and Sicily are the chief districts where they are grown in Europe, but they are cultivated in Algiers, the West Indies, and Brazil.

Grapes are exported from Spain and Portugal and from Spain as raisins, when dried. Currants are a form of seedless grape with a very limited geographical distribution confined to one small part of Greece. But it

is as the fruit from which wine is made that the grape is most commercially noticeable. The limits within which the vine can be grown are very wide, but, practically speaking, the wines of France, Spain, Portugal, Italy, and Germany are the most important.

Beet is largely grown on the continent of Europe for sugar making, especially in Germany and in western and south-west Russia.

Flax is a very interesting and important plant, and is remarkable for the number of different products that it supplies. The most important is the fibre of the stem, which is used in making linen, probably the oldest of the woven materials. The seed of the plant is linseed, which is used as affording a valuable oil, the remainder of the compressed seed being used as a food for cattle. The shorter fibres of the plant, which are not used for weaving, are known as tow.

This is spun into cord and string. Linen rags are used in paper-making, and they make the best paper. Flax is grown through a very wide range of climate, but the conditions for obtaining the best fibre render the seed nearly valueless for oil and vice versa. In the cold climates such as Russia it is grown for the sake of the fibre; in warm climates like India the seed is the first consideration.

Cotton is the woolly fibres surrounding the seeds of plants of the genus gossypium, of which there are, however, several species. It was originally introduced from the New World, where it is still, perhaps, most extensively grown, but important centres for its cultivation are also India and Egypt. It is also largely grown in China, but there chiefly for home consumption. The length of the cotton fibre is on an average about one inch, but one species has a "staple" of about two inches. To grow cotton satisfactorily a long summer is necessary, with a moderate amount of moisture; frost is particularly detrimental to its successful cultivation. It is exported in bales of cotton wool, which is freed from the seed by a process called "ginning."

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GROWING TOBACCO UNDER COTTON.

An interesting Canadian experiment. Tobacco will grow almost anywhere, but the quality varies very considerably according to conditions of soil, temperature, etc.

Tobacco again is naturally a product of America, though it is now grown all over the world wherever the climate is suitable. The United States of America is still the largest producer in the world, but important quantities are grown in Cuba (Havana tobacco being the most esteemed for cigars of any kinds), Brazil, Asiatic Turkey, Hungary, Russia, Germany, France, etc. In quality tobacco varies very much according to the different conditions of soil, temperature, etc., under which it is grown. It will flourish almost anywhere in the tropics and even in the cooler temperate climates as far north as Scotland. It must be protected from frost in the early stages of growth.

Opium is the coagulated juice of a species of poppy. Its principal source of production is India, but it is also grown in Asia Minor.

Tea consists of the dried leaves of two or three shrubs or trees allied to the Camellia. It is very hardy, and even severe frosts do not kill it, though they check the growth. It grows best in a warm, moist, equable climate, and a good drainage is essential. These conditions are best found on the mountain slopes of the tropics, etc., and the height at which it is grown naturally varies with the latitude. China was originally the greatest tea producing country, but it is now grown to a much greater extent in India

and Ceylon. The United Kingdom takes about one-half of the entire tea production of the world which is exported; Russia (the Russian being an inveterate tea drinker) is the next largest consumer.

Coffee consists of the seeds of various species of trees or shrubs, but chiefly of the plant Coffea arabica. A warm and moist climate is necessary, but the heat must not be too great. Prolonged frost is fatal to the growth of coffee, though it can endure occasional periods of low temperature. Arabia was originally the chief region where coffee was cultivated, but it is now grown in the largest quantity in Brazil. Other countries with important coffee plantations are India, Ceylon, Java, and Central America.

Cacao (cocoa) is produced from the bean of a tropical American tree. The seeds or beans contain about one-half their weight of the so-called "cocoa butter," a fat which has the property of never becoming rancid. It is grown nearer to the Equator than coffee as it requires generally a higher temperature and a great deal of moisture. It is chiefly grown in Equador, Venezuela,

Photo: by permission of Messrs. Lipton, Ltd.

TEA PICKING IN CEYLON.

Picking begins in the middle of April. China was at one time the great tea-producing country, but tea is now grown more extensively in India and Ceylon.

northern Brazil, and also in the island of St. Thomas in the gulf of Guinea.

It is curious that in all three of the last-named vegetable products the active principle that gives them their value and stimulating properties is a chemical substance or alkaloid of very closely allied composition.

Rice is the characteristic cereal of the monsoon district of south-east Asia. There are many varieties, and those which are most abundantly produced require a high summer temperature, and must be grown in fields that can be flooded at certain stages of the growth of the plant.

The principal rice-producing regions are Bengal, Japan, and Indo-China. It is also grown in the United States of America, and even in Europe in certain parts of Italy.

Sugar Cane is a member of the grass family, the juice of which, found in the stem, yields sugar. In cultivation the plant requires very little attention, and the amount of sugar produced by a given area planted with it is nearly twice as much as is produced by the cultivation of beet. It is grown all over tropical and sub-tropical areas, the West Indies, Guiana, and Brazil being the chief centres in the New World; India, Java, and the Philippines, etc., in the Old.

Jute is the fibre of one or two species of plants grown in India in the north-eastern parts of Bengal. It is largely manufactured at Dundee in Scotland into a coarse material used principally for making sacks, though in combination it is used with other materials in the manufacture of carpets, curtains, and even velvets.

Hemp is the fibre of another plant obtained from the leaves, instead of from the stem. Being very strong it is employed in the manufacture of rope, but in the Philippine Islands, where it is largely grown, it is woven into quite delicate tissues.

India-Rubber is the coagulated juice of various species of tropical trees. It is obtained from the Amazon valley, where the best quality, known as Para rubber, is grown. Other regions where rubber is cultivated are Central America, other parts of Brazil, India, Borneo, and Africa.

Photo: J. E. Coovert, Memphis.

GATHERING COTTON

Cotton is the woolly fibres surrounding the seeds of plants of the genus gossypium. Introduced originally from the New World, it is now grown extensively in India and Egypt.

The most important spices are pepper, derived from a creeping plant belonging to the East Indies, and still practically all imported from there; ginger — the dried root of a plant originally native in south-east Asia, but now grown in the West Indies and West Africa; cinnamon — the bark of the twigs of two different kinds of trees grown mostly in Ceylon and China.

Among the trees used for their wood we will notice: mahogany, mostly imported from tropical America, the best kinds coming from Hayti.

Teak is grown in the East Indies and Burma. It is particularly valuable as it contains an oil which preserves from rust the iron nails and bolts which may be used to fasten together articles made from this timber.

Cedar is the name given to the wood of a variety of trees none of which is the true Cedar of Lebanon. Most of the cedar of commerce is derived from the West Indies and Central America.

Firs and pines are obtained in Europe from Scandinavia and Russia. In America, the United States and Canada are the chief exporting countries.

Vegetable dyes are not now of so great importance as formerly owing to the fact that chemistry has largely replaced them in the market by synthetic compounds. We may, however, mention logwood, from which a dull red colour is obtained. This is exported from the West Indies and Honduras. Indigo is obtained from a native shrub in the south-east of Asia, but grown also in the New World. Our chief source of the natural dye is India, but it is now cultivated to a much less extent than formerly, owing to the production of synthetic indigo. The natural dye, however, has advantages over the manufactured product.

Another dye obtained from India is the catechu. It is taken from various species of Uncaria, Areca, and Acacia. The wood, fruit and leaves of these plants are extracted with boiling water. The liquid is then evaporated, leaving the catechu. It is mostly used for producing brown or drab colours. Cotton is a suitable texture for this dye; wool is seldom used. Catechu has been used with copper sulphate for dyeing the khaki on military clothing. C. J. S.

Photo: Underwood and Underwood.

AMERICA'S HUGE WHEATFIELDS

A team of thirty-three horses thrashing and sacking at Walla-Walla, Washington.

Continued from page 303.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.

(M. A. Lewenz, M.A.[Lond.]).

ARITHMETIC.—XIV

109.—Practice (*continued*).

The price of certain other numbers of articles is easily calculated.

60. Since 60d. = 1 crown, we call the pence in the price of each crowns.

Thus, to find the cost of 60 articles at 3s. 2½d. each.

3s. 2½d. = 38½d. ∴ cost of 60 = 38 crowns and 1 half-crown = £9 10s. + 2s. 6d. = **£9 12s. 6d.**

120. Since 120d. = 1 half-sovereign, we call the pence in the price of each half-sovereigns.

To find the cost of 120 things at 5s. 7¾d each.

5s. 7¾d. = 67¾d. ∴ price 120 = 67 half-sovereigns and ¾ of a half-sovereign = £33 10s. + 7s. 6d. = **£33 17s. 6d.**

240. Since 240d. = 1 sovereign, we call the pence in the price of each pounds.

Thus, to find the cost of 240 articles at 10¼d. each.

Price of 240 = £10¼ = **£10 5s.**

48. Since 48 farthings = 1 shilling, we call the number of farthings in the price of each shillings.

Thus, to find the cost of 48 articles at 5s. 2½d. each.

5s. 2½d. = 250 farthings ∴ price of 48 = 250s. = **£12 10s.**

252. Since 252d. = 1 guinea, we call the pence in the price of each guineas.

Thus, to find the cost of 252 articles at 1s. 2¼d. each.

1s. 2¼d. = 14¼d. ∴ price of 252 = 14 guineas and ¼ of a guinea = £14 14s. + 5s. 3d. = **£14 19s. 3d.**

Similarly, the price of **126** and of **63** articles can be found by calling the pence in the price of each half-guineas and quarter-guineas respectively.

100, 1,000. When finding the price of **100 or 1,000,** etc., articles, it is best to decimalise the price of the single article and then multiply.

Thus, to find the cost of 1,000 articles at 4s. 3½d. each.

4s. 3½d. = £·214583̇ ∴ price of 1,000 = £214·583̇ = **£214 11s. 8d.**

Similarly **25, 50, 250** will be ¼ and ½ the price of 100, and ¼ the price of 1,000 respectively.

110. Certain numbers which are of frequent occurrence can be split up so as to come under one or the other of the above. Given the cost per day, to find the cost per year.

A year = 365 days; 365 = 240 + 120 + 5 ∴ for every penny in the price per day, the price per year will be 1 sovereign, 1 half-sovereign, and 5 pence.

Thus, to find the cost per year, if the cost per day is 2s. 7½d.

2s. 7½d. = 31½d ∴ cost per year = 31 sovereigns + ½ sovereign + 31 half-sovereigns + ¼ sovereign + 31 × 5 pence + ½ of 5 pence = £31 + 32 half-sovereigns + 5s. + 155d. + 2½d. = £31 + £16 + 5s. + 12s. 11d. + 2½d. = **£47 18s. 1½d.**

Again, the number of working days in a year is 313.

313 = 252 + 60 + 1 ∴ for every penny in the cost per day, the cost per year will be 1 guinea + 5 shillings + 1d.

Thus, to find the cost of 313 days at 3s. 4½d. per day.

3s. 4½d. = 40½d. ∴ cost per 313 days = 40½ guineas + 40½ crowns + 40½ pence = £42 + 10s. + 6d. + £8 2s. 6d. + 3s. 4½d. = **£50 16s. 4½d.**

Price per lb.—Since 16 oz. = 1 lb., if the price per oz. is given, bring the price to farthings, multiply by 4, and call this result pence.

Thus, to find the cost per lb. at 6½d. an oz.

6½ = 26 farthings; 26 × 4 = 104 ∴ cost per lb. = 104d. = **8s. 8d.**

Price per cwt.—112 lb. = 1 cwt.; 112 = 100 + 12, multiply the price in pence by 100 and add as many shillings as there are pence in the price.

Thus, to find the price per cwt., if the price per lb. is 1s. 3½d.

1s. 3½d. = 15½d. ∴ price per cwt. = 1,550d. + 15s. 6d. = 129s. 2d. + 15s. 6d. = 144s. 8d. = **£7 4s. 8d.**

Price per ton.—Since 1 ton = 20 cwt. the same method will apply, only we must call the shillings pounds.

Thus, to find the price per ton at 1s. 4d. per lb.

1s. 4d. = 16d. 1,600d. + 16s. = 149⅓s.

∴ price per ton = £149⅓ = **£149 6s. 8d.**

Price per mile.—1 mile = 1,760 yards = (2,000 — 240) yards. Hence we multiply the price per yard by 2,000, and from this subtract

as many pounds as there are pence in the price per yard.

Thus, find the price per mile at 4s. $3\frac{1}{2}$d. per yard.

4s. $3\frac{1}{2}$d. = £·214583

2,000 × £·214583 = £429·166

subtract £51½ £51·5

£377·666 = **£377 13s. 4d.**

Price per acre.—1 acre = 4,840 sq. yd.

Now 4,840d. = £20 3s. 4d. = £$20\frac{1}{6}$. Hence we multiply the cost per square yard reduced to pence by $20\frac{1}{6}$ and call the result pounds.

Thus, to find the price per acre at 10s. 9d. per square yard.

10s. 9d. = 129d.

$$£129 \times 20\tfrac{1}{6} = £2{,}580 + \frac{£129}{6}$$

= £2,580 + £21 10s. = **£2,601 10s.**

111. In reducing pence to pounds, it is convenient to remember that 120d. make 1 half-sovereign; hence, we can divide the pence first by 10 and then by 12, which gives the number of half-sovereigns.

Thus, reduce 5,986d. to pounds

5,986d. = 49 half-sovereigns + 106 pence

= **£24 18s. 10d.**

The above are by no means the only short methods of working such calculations. They are merely given as an indication to the student as to how he may save labour.

Areas and Volumes

112. (1) A **parallelogram** is a four-sided figure of which the opposite sides are parallel.

(2) A **rectangle** is a parallelogram whose angles are right angles.

(3) When we measure the **area** of a figure we measure the extent of its surface. We measure it in terms of some unit of area such as a square foot, a square centimetre, and so on.

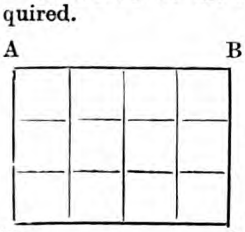
An area has length and breadth.

(4) **A solid has length, breadth and thickness.** When we measure the **volume** or **capacity** of a solid, we measure the amount of space it contains or takes up. This is measured in terms of some unit of volume or capacity such as a cubic inch or a litre.

We shall here only deal with the areas and volumes of rectangles and rectangular solids.

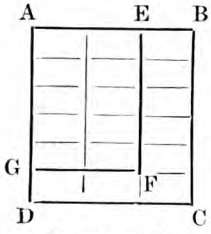
113. *To find the area of a rectangle.*

Let A B C D be the rectangle whose area is required.



Suppose A B is 4 inches long and A D is 3 inches long. Divide A B into 4 equal parts and A D into 3 equal parts, and draw lines through these points of division parallel to the sides of the rectangle, as in the figure. It is clear that the rectangle is divided into squares, each of whose sides is 1 inch long, and each of which is by definition a square inch. It is easy to see that the number of these squares making up the rectangle is equal to the product of the number of inches in A B and the number of inches in A D.

This reasoning applies to any rectangle whose length and breadth can be expressed as integers. Now let us consider the case in which the length and breadth cannot be expressed as integers.



Suppose in the rectangle A B C D that A B = $\frac{3}{2}$ inch and A D = $\frac{6}{5}$ inch. Let A E F G be a square inch. Divide A E into two equal parts and A G into five equal parts. Draw lines parallel to the sides, as in the figure. Then it is clear that the rectangle A B C D is divided into 3 × 6 equal rectangles of which the square A E F G contains 2 × 5.

Now if 2 × 5 of these rectangles make up 1 square inch, it follows that 3 × 6 of these rectangles must make up $\frac{3 \times 6}{2 \times 5}$ square inches, i.e. $\frac{3}{2} \times \frac{6}{5}$ square inches.

That is, the rectangle A B C D contains $\frac{3}{2} \times \frac{6}{5}$ square inches.

Hence it follows that the number of square inches, feet, yards, etc., in a rectangle is equal to the product of the number of inches, feet, yards, etc., in the length, and the number of inches, feet, yards, etc., in the breadth.

We may state this shortly, thus:

Area = length × breadth.

The length and breadth must, of course, be expressed in the same units before multiplication.

Thus, to find the area of a rectangle which is 2 yards long and 2 feet broad, we must first either reduce the yards to feet or the feet to yards.

The area will = 2 × 3 ft. × 2 ft. = 12 sq. ft. = 1 sq. yd. 3 sq. ft., or the area = 2 yd. × $\frac{2}{3}$ yd. = $\frac{4}{3}$ sq. yd. = **1 sq. yd. 3 sq. ft.**

Example:—

Find the area of a rectangle whose length is 13 ft. 4 in. and breadth is 9 ft. 2 in.

$$\text{area} = 13\tfrac{1}{3} \times 9\tfrac{1}{6} \text{ sq. ft.} = \frac{40}{3} \times \frac{55}{6} \text{ sq. ft.}$$

$$= \frac{1{,}100}{9} \text{ sq. ft.} = 122\tfrac{2}{9} \text{ sq. ft.}$$

= **13 sq. yd. 5 sq. ft. 32 sq. in.**

Here we have expressed both dimensions in feet. We might have expressed both in yards or inches.

Thus—

$$\text{Area} = 4\tfrac{1}{9} \times 3\tfrac{1}{18} \text{ sq. yd.} = \frac{40}{9} \times \frac{55}{18} \text{ sq. yd.}$$

= **13 sq. yd. 5 sq. ft. 32 sq. in.**

It depends upon what denomination we wish the answer to be in whether we reduce the dimensions to yards or feet, etc.

114. If the area of a rectangle be known, and also the length (or the breadth), then it is easy to find the breadth (or the length), as the case may be.

Thus, to find the breadth of a rectangle whose area = 9 sq. yd. 3 sq. ft., and whose length = 5 yd. 1 ft.

Since area = length × breadth

$$\therefore \frac{\text{area}}{\text{length}} = \frac{\text{length} \times \text{breadth}}{\text{length}} = \text{breadth.}$$

Hence breadth $= \frac{9\frac{1}{3}}{5\frac{1}{3}}$ yd. $= \frac{\frac{28}{3}}{\frac{16}{3}}$ yd. $= \frac{7}{4}$ yd.

= 1 yd. 2 ft. 3 in.

The student should note that we expressed the area in square yards and the length in yards before dividing, i.e. we reduced both area and length to the same denomination. We might equally well have reduced both to feet or inches. Thus—

$$\text{Breadth} = \frac{\text{area}}{\text{length}} = \frac{84}{16} \text{ ft.} = 5\tfrac{1}{4} \text{ ft.}$$

= 1 yd. 2 ft. 3 in.

Exercise 38

(1) Find the cost of 3,478 articles at (*a*) £1 13s. 4d.; (*b*) £166 13s. 4d.; (*c*) 16s. 8d.; (*d*) £4 3s. 4d.; (*e*) £3 6s. 8d.

(2) Find the cost of a dozen and a gross of articles at (*a*) 2s. 9d.; (*b*) 3s. 7½d.; (*c*) 7s. 2¼d.; (*d*) 11¾d. each.

(3) Find the price of a score and a hundred of things at (*a*) 1¾d., (*b*) 7½d., (*c*) 1s. 11¾d., (*d*) 3s. 4½d. each.

(4) Reduce 4,873d., 56,420d., 7,851d., 36,542d. to £ s. d.

(5) What will 240 articles cost at (*a*) 2½d., (*b*) 7¾d., (*c*) 1s. 0½d., (*d*) 2s. 3d. each?

(6) What will 120 articles cost at (*a*) 4¾d., (*b*) 10½d., (*c*) 1s. 9d., (*d*) 2s. 11¾d. each?

(7) What will 252 articles cost at (*a*) 1¾d., (*b*) 3s. 4½d., (*c*) 7s. 6d. each?

(8) What is the price of (*a*) 100, (*b*) 1,000, (*c*) 250, (*d*) 63 articles at (i) 5¾d. each, (ii) 7s. 4½d. each?

(9) How much is 365 days at (*a*) 2s. 6d., (*b*) 3s. 6½d.?

(10) How much is 313 days at (*a*) 4s. 7d., (*b*) 10s. 3½d.?

(11) Things cost (*a*) 2½d., (*b*) 6¾d., (*c*) 1s. 0½d., (*d*) 2s. 9d. per oz. What are they per lb.?

(12) What is the price per mile at (*a*) 2¾d., (*b*) 8½d., (*c*) 1s. 4d. per yard?

(13) What is the price of a cwt. and of a ton at (*a*) 2¾d., (*b*) 8½d., (*c*) 1s. 4d. per lb.?

(14) What is the price of an acre at (*a*) 3s. 6d., (*b*) 5s., (*c*) 7s. 2d. per square yard?

Key to Exercise 36

(1) £62 8s. 6d. (2) £271 5s. 4d. (3) £250,014 13s. 8½d. (4) £12,231 8s. 1½d. (5) £467 1s. 6⅔d. (6) £447 9s. 0¼d. (7) £51 8s. $0\frac{3}{16}$d.

Key to Exercise 37

(1) 5·54 centimes per kilometre; 86·3 centimes per 50 kilogrammes per 100 kilometres.

(2) (i) Five more significant figures are required; (ii) 0·311; (iii) The integral quotient is 16, and the remainder is then 0·25 correct to two places of decimals.

(3) 0·4,097; 41 parts of zinc, 59 parts of copper.

(4) 1·7 cwt.; 3s. 1d.

(5) 111·82 francs; $1\frac{6}{19}$ kilogrammes. M. A. L.

ALGEBRA.—XIV

94. Simultaneous Equations.

If a single equation contains two or more variables (or unknown quantities) it can be satisfied by an infinite number of values of the variables, for by giving any values whatever to all but one of the variables, we obtain an equation which determines that one variable.

If there are two equations, one or both of which contains two variables (or as many equations as there are variables), each equation taken singly has an indefinite number of solutions; but if both (or all) equations are to be satisfied by the same values of the variables, then only certain solutions are possible.

When two or more equations are to be satisfied by the same values of the variables, they are known as **simultaneous equations.**

The degree of an equation involving $x, y, z \ldots$ is the degree of that term which is of the highest dimensions in $x, y, z \ldots$.

Thus $ax + bcy + d^2z = m^3$ is of the first degree
$a^2x + bxy + y + z = 0$ „ second „
$x^3 + y^3 + z^3 = 0$ „ third „

95. Equations of the first degree.

Every equation of the first degree can be reduced to the form $ax + by + cy + \ldots = K$
Where $a, b, c \ldots$ K are known quantities.

Equations with two variables.

To find the values of x and y which satisfy the two equations

$$ax + by = c \quad \ldots\ldots\ldots\ldots\ldots \text{(i)}$$
$$a'x + b'y = c' \quad \ldots\ldots\ldots\ldots\ldots \text{(ii)}$$

Multiply every term of (i) by b', the coefficient of y in (ii) and every term of (ii) by b, the coefficient of y in (i).

Then we have

$$ab'x + bb'y = b'c \quad \ldots\ldots\ldots\ldots\ldots \text{(iii)}$$
$$a'bx + bb'y = bc' \quad \ldots\ldots\ldots\ldots\ldots \text{(iv)}$$

Hence subtracting (iv) from (iii)

$$(ab' - a'b)\,x = b'c - bc'$$
$$\therefore x = \frac{b'c - bc'}{ab' - a'b}.$$

Substitute this value for x in (i), and we get

$$\frac{a\,(b'c - bc')}{ab' - a'b} + by = c$$
$$\therefore by = \frac{c\,(ab' - a'b) - a\,(b'c - bc')}{ab' - a'b}$$
$$\therefore y = \frac{b(ac' - a'c)}{b(ab' - a'b)} = \frac{a'c - ac'}{a'b - ab'}.$$

Or we may find the value of y independently, in the same way as we found the value of x, by multiplying each term of (i) by a', the coefficient of x in (ii), and each term of (ii) by a, the coefficient of x in (i).

Having found the value of x, we can write down the value of y, for y bears the same relation to b and b' that x does to a and a'. Consequently we change x into y, a into b and b into a, a' into b', and b' into a'.

Thus from $x = \frac{b'c - bc'}{ab' - a'b}$ we get $y = \frac{a'c - ac'}{a'b - ab'}$.

From this it will be clear that the equations

$$ax + by = c$$
$$a'x + b'y = c'$$

may be written

$$\frac{x}{b'c - bc'} = \frac{y}{ac' - a'c} = \frac{1}{ab' - a'b}.$$

In solving two simultaneous equations, we deduce from the two equations a third from which one of the variables has been eliminated.

Examples :—

(1) Solve $3x + 2y = 5$ ..... (i)
$2x - 3y = 1$ ..... (ii)

Multiplying (i) by 3 and (ii) by 2 we get

$9x + 6y = 15$ ..... (iii)
$4x - 6y = 2$ ..... (iv)

adding (iii) and (iv) we have

$$13x = 17 \therefore x = \frac{17}{13}$$

substituting this value of x in (iv) we get

$$\frac{68}{13} - 6y = 2 \therefore 6y = \frac{42}{13} \therefore y = \frac{7}{13}.$$

(2) Solve $6x + y = 23$ ..... (i)
$2x + 3y = 21$ ..... (ii)

from (i) $y = 23 - 6x$

Substituting this value of y in (ii) we get

$2x + 69 - 18x = 21$
$\therefore 16x = 48 \therefore x = 3$

substituting this value of x in (i) we get

$18 + y = 23 \therefore y = 5$

Example 1 might have been solved in a similar way to Example 2.

(3) Solve $\frac{9}{x} - \frac{4}{y} = 2$ ..... (i)
$\frac{18}{x} + \frac{8}{y} = 10$ ..... (ii)

These may be treated as simultaneous equations of the first degree in X and Y where $\frac{1}{x} = X$ and $\frac{1}{y} = Y$

thus (i) becomes

$9X - 4Y = 2$ ..... (iii)

and dividing (ii) throughout by the common factor 2 we have

$9X + 4Y = 5$ ..... (iv)

subtracting (iii) from (iv) we get

$$8Y = 3 \therefore Y = \frac{3}{8} \therefore y = \frac{8}{3}$$

and substituting for Y in (iii) we get

$$9X - \frac{3}{2} = 2 \therefore X = \frac{7}{18} \therefore x = \frac{18}{7}.$$

(4) Solve $13x - 14y = -1$ ..... (i)
$16x + y = 17$ ..... (ii)

Solving by means of the formulae given at the end of § 95, we have

$$\frac{x}{1 \times (-1) - (-14) \times 17} = \frac{y}{13 \times 17 - 16 \times (-1)} = \frac{1}{13 \times 1 - 16 \times (-14)}$$

whence $x = \frac{237}{237} = 1$ and $y = \frac{237}{237} = 1$.

(5) Solve $ax + by = ab$ ..... (i)
$x + y = a + b$ ..... (ii)

multiplying (ii) by b we have

$bx + by = ab + b^2$ ..... (iii)

subtracting (i) from (iii) we have

$$(b - a)x = b^2 \therefore x = \frac{b^2}{b - a}$$

substituting this value of x in (ii) we get

$$\frac{b^2}{b - a} + y = a + b$$
$$\therefore y = \frac{-a^2}{b - a} = \frac{a^2}{a - b}.$$

Exercise 19

Solve the following simultaneous equations—

(1) $x + 2y = 13.$
$3x + y = 14.$

(2) $21x - 50y = 60.$
$28x - 27y = 199.$

(3) $\frac{2x}{3} + y = 16.$
$x + \frac{y}{4} = 14.$

(4) $\frac{x}{7} + \frac{y}{5} = 1\frac{2}{7}.$
$x + \frac{y}{3} = 4\frac{2}{3}.$

(5) $bx + ay = 2ab.$
$a^2x + b^2y = a^3 + b^3.$

(6) $x + \frac{3}{y} = \frac{7}{2}.$
$3x - \frac{2}{y} = \frac{26}{3}.$

(7) $\frac{4}{x} - \frac{3}{y} + 5 = \frac{6}{x} + \frac{3}{y} = 10.$

(8) $\frac{x + y}{a + b} + \frac{x - y}{a - b} = 2$
$ax + by = a^2 + b^2.$

(9) $a^n x + b^n y = 2a^n b^n$
$b^n x + a^n y = a^{2n} b^{2n}$

96. We have seen that the values of x and y which satisfy the equations $ax + by = c$ .... (i)
$a'x + b'y = c'$ ... (ii)
are given by $(ab' - a'b)x = cb' - c'b$.... (iii)
and $(ba' - b'a)y = ca' - c'a$.... (iv)

(iii) and (iv) give a simple finite value for x and for y if $ab' - a'b \neq 0$.

If $ab' - a'b = 0$ x will be infinite unless $cb' - c'b = 0$.

If $ab' - a'b = 0$ and $cb' - c'b = 0$ any value of x will satisfy the equation (iii).

Similarly y will be infinite if $ab' - a'b = 0$ unless $ca' - c'a = 0$; and if $ab' - a'b = 0$ and $ca' - c'a = 0$ then any value of y will satisfy (iv).

If $ab' - a'b = 0$ then $\frac{a}{a'} = \frac{b}{b'}$, and if $ab' - a'b = 0$ and $cb' - c'b = 0$ then $\frac{a}{a'} = \frac{b}{b'} = \frac{c}{c'}$.

Equations are said to be **inconsistent** if they cannot be satisfied by finite values of x and y. Thus equations (i) and (ii) above are inconsistent if $\frac{a}{a'} = \frac{b}{b'}$, unless each of these fractions $= \frac{c}{c'}$, in which case the equations are **indeterminate**, and the two equations are equivalent to one, as may be seen by multiplying equation (i) by $\frac{a'}{a}$ which gives equation (ii).

If a and a' both $= 0$, then from (i) $y = \frac{c}{b}$ and from (ii) $y = \frac{c'}{b'}$ and these are inconsistent unless $\frac{c}{b} = \frac{c'}{b'}$.

If a and a' both $= 0$ and $\frac{c}{b} = \frac{c'}{b'}$, then equations (i) and (ii) are both satisfied by making $y = \frac{c}{b}$ (and giving x any value whatever.

97. Equations with three variables. To solve the three equations—

$$ax + by + cy = d \quad \ldots\ldots\ldots \text{(i)}$$
$$a'x + b'y + c'z = d' \quad \ldots\ldots\ldots \text{(ii)}$$
$$a''x + b''y + c'z' = d'' \ldots\ldots\ldots \text{(iii)}$$

This may be done in the following ways :

(a) by successive elimination.

Multiply (i) by c' and (ii) by c ; then we get

$$ac'x + bc'y + cc'z = dc'$$
$$a'cx + b'cy + cc'z = d'c$$

and by subtraction

$$(ac' - a'c)\,x + (bc' - b'c)\,y = dc' - d'c \ldots\ldots \text{(iv)}$$

Similarly by multiplying (i) by c'' and (iii) by c and subtracting we get

$$(ac'' - a''c)\,x + (bc'' - b''c)\,y'dc'' - d''c \ldots\ldots \text{(v)}$$

(iv) and (v) are two equations involving only two variables, and making use of the formulae obtained in § 95 we have

$$x = \frac{(bc'' - b''c)(dc' - d'c) - (bc' - b'c)(dc'' - d''c)}{(ac' - a'c)(bc'' - b''c) - (ac'' - a''c)(bc' - b'c)}$$

(b) by undetermined multipliers.

Multiply (i) by λ and (ii) by μ and add to (iii) ; then we get $x(\lambda a + \mu a' + a'') + y(\lambda b + \mu b' + b'') + z(\lambda c + \mu c' + c'') = \lambda d + \mu d' + d''$.

Now choose λ and μ so that the coefficients of y and z may both be zero. Then we have

$$x = \frac{\lambda d + \mu d' + d''}{\lambda a + \mu' a + d''}$$

Now these values of λ and μ are found from the equations $\lambda b + \mu b' + b'' = 0$, $\lambda c + \mu c' + c'' = 0$

and $\therefore \dfrac{\lambda}{b'c'' - b''c'} = \dfrac{\mu}{b''c - bc''} = \dfrac{1}{bc' - b'c}$

Hence $x =$

$$\frac{d(b'c'' - b''c') + d'(b''c - bc'') + d''(bc' - b'c)}{a(b'c'' - b''c') + a'(b''c' - bc'') + a''(bc' - b'c)}$$

If we divide the numerator and denominator of the value of x found by the method (a) we shall see that the values are the same.

Having found the value of x, we can find the value of y and z by making the appropriate cyclical changes.

Examples :—

(1) Solve—

$x + 2y + 3y = 3x + y + 2z = 2x + 3y + z = 6$

we have $x + 2y + 3z = 6 \ldots\ldots\ldots\ldots$ (i)

$3x + y + 2z = 6 \ldots\ldots\ldots\ldots$ (ii)

$2x + 3y + z = 6 \ldots\ldots\ldots\ldots$ (iii)

Multiply (i) by 2 then $2x + 4y + 6z = 12 \ldots$ (iv)

Multiply (ii) by 3 then $9x + 3y + 6z = 18 \ldots$ (v)

Subtracting, $7x - y = 6 \ldots\ldots\ldots\ldots$ (vi)

Multiply (iii) by 3 then $6x + 9y + 3z = 18 \ldots$ (vii)

Subtracting (i) from (vii) $5x + 7y = 12 \ldots$ (viii)

Multiply (vi) by 7 then $49x - 7y = 42 \ldots$ (ix)

adding (viii) and (ix) $54x = 54$

$\therefore x = 1$

substituting this value of x in (vi) or (viii) we get $y = 1$

substituting these values of x and y in (i), (ii) or (iii) we get $z = 1$

Hence the solution is $x = 1$, $y = 1$, $z = 1$.

(2) Solve—

$$x + y + z = 2a + 2b + 2c \quad \ldots\ldots\ldots \text{(i)}$$
$$ax + by + cz = 2bc + 2ca + 2ab \ldots\ldots \text{(ii)}$$
$$(b - c)\,x + (c - a)\,y + (a - b)\,z = 0 \quad \text{(iii)}$$

Multiply (i) by c and subtract (ii).

Then $(c - a)\,x + (c - b)\,y = 2(c^2 - ab) \ldots\ldots$ (iv)

Again multiply (i) by $(a - b)$ and subtract (iii)

$(a - 2b + c)\,x + (2a - b - c)\,y = 2(a + b + c)(a - b) \ldots\ldots$ (v)

Using the formula obtained in § 95 for equations (iv) and (v)

$x =$

$$\frac{2(2a - b - c)(c^2 - ab) - 2(c - b)(a + b + c)(a - b)}{(c - a)(2a - b - c) - (a - 2b + c)(c - b)}$$

$= b + c$

Hence $y = c + a$ and $z = a + b$.

Exercise 20

Solve—

(1) $x + y + z = 1$, $2x + 3y + z = 4$, $4x + 9y + z = 16$

(2) $y + z - x = 2a$, $z + x - y = 2b$, $x + y - z = 2c$

(3) $ax + by + cz = a$, $bx + cy + az = b$, $cx + ay + bz = c$

(4) $ax + by + cz = p$, $a^2x + b^2y + c^2z = p^2$, $a^3x + b^3y + c^3z = p^3$

Note if 4 equations with 4 variables are to be solved the same methods must be applied.

Key to Exercise 17

(1) 13, 5. (2) £6,480. (3) 15 ft. ; 12 ft. (4) A £12 ; B £24. (5) 576. (6) 5 h. 48 m.

M. A. L.

GEOMETRY.—XIII

Proposition 70.—Theorem

1. *The angle in a semicircle is a right angle.*

2. *The angle in a segment greater than a semicircle is less than a right angle.*

3. *The angle in a segment less than a semicircle is greater than a right angle.*

1. (Fig. 2.)—Let θ be $\angle$ at C in a semicircle A P B.

It is required to prove that θ is a rt. $\angle$.

Proof.—Draw the radius O C.

$\alpha + \beta + (\gamma + \delta) = 2$ rt. $\angle$s ($\angle$s of $\triangle$ A C B) (Prop. 4, Cor. 2).

O A C and O B C are isos. $\triangle$s

$\therefore \alpha = \gamma$ and $\beta = \delta$ (Prop. 6).

$\therefore \gamma + \delta + (\gamma + \delta) = 2$ rt. $\angle$s

$\therefore \gamma + \delta = 1$ rt. $\angle$.

2. (Fig. 1.)—Let θ be $\angle$ at C in segment A P B greater than a semicircle.

It is required to prove that $\theta <$ rt. $\angle$.

Proof.—Since θ is of the same magnitude wherever we take C on arc A P B, we choose the position of C so that A C is a diameter.

Then $\theta + \beta < 2$ rt. $\angle$s (2 $\angle$s of a $\triangle$).

But β is an $\angle$ in the semicircle A B C

$\therefore \beta = 1$ rt. $\angle$ $\therefore \theta <$ rt. $\angle$.

3. (Fig. 3.)—Let θ be $\angle$ at C in segment A P B less than a semicircle.

It is required to prove that $\theta >$ rt. $\angle$.

Proof.—Take any point D in arc A Q B and join A D, B D.

A C B D is a cyclic quadrilateral

$\therefore \theta + \varphi = 2$ rt. $\angle$s.

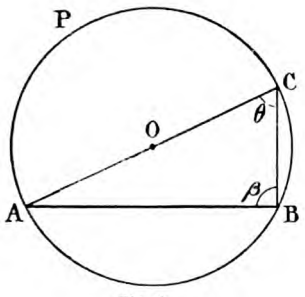


Fig. 1.

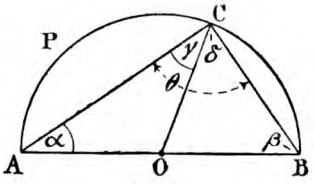


Fig. 2.

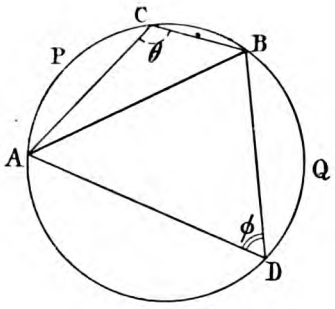


Fig. 3.

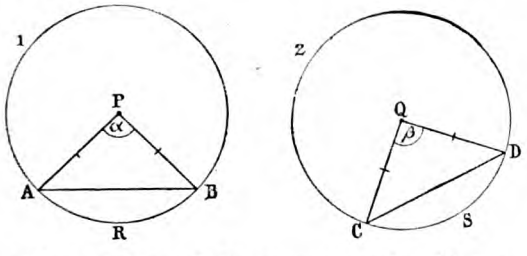
But φ is in a segment $>$ semicircle
$\therefore \varphi <$ rt. $\angle$
$\therefore \theta >$ rt. $\angle$

Proposition 71.—Theorem

In equal circles, (1) *if two arcs subtend equal angles at the centre then the arcs are equal.*

Converse.—(2) *If the arcs be equal then the angles they subtend are equal.*

Let A R B, C S D be arcs of the equal ⊙s 1 and 2.
Place ⊙ 1 on ⊙ 2 so that centre P coincides with centre Q; then ∵ all radii of 1 = all radii of 2, the ⊙s coincide.



Turn ⊙ 1 round the common centre till A coincides with C.

1. If $\alpha = \beta$ **it is required to prove** that arc A R B = arc C S D.

Proof.—Since P coincides with Q and A coincides with C.
P A lies on Q C.
∵ $\alpha = \beta$, P B lies along Q D
and since P B = Q D ∴ B coincides with D
∴ arc A R B coincides with arc C S D,
i.e. arc A R B = arc C S D.

2. If arc A R B = arc C S D
It is required to prove that $\alpha = \beta$.

Proof.—Since arc A R B = arc C S D and A has been placed on C ∴ B lies on D
∴ P B coincides with C D
∴ α coincides with β, i.e. $\alpha = \beta$.

Corollary 1.—*If* $\alpha = \beta$, *the sectors* P A R B, Q C S D *are equal.*

Also if arc A R B = arc C S D they are equal (for they may be made to coincide).

Corollary 2.—*$\angle$s at the circumference are subtended by equal arcs* (*for $\angle$s at circumference* $= \frac{1}{2}$ *$\angle$s at centre*).

Corollary 3.—*If* $\alpha = \beta$, *chord* A B = *chord* C D.

Also if arc A R B = arc C S D, chord A B = chord C D (for in both cases they may be made to coincide).

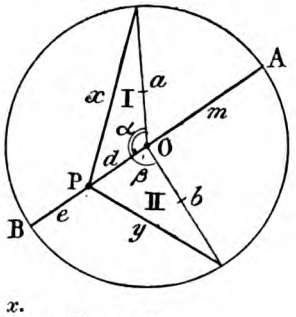
Corollary 4.—*If chord* A B = *chord* C D, *then* $\triangle$ A P D $\equiv$ $\triangle$ C Q D (∵ P A = Q C, P B = Q D *and* A B = C D)
∴ $\alpha = \beta$ and ∴ arc A R B = arc C S D.

Proposition 72.—Theorem

If from a point, not the centre, within a circle straight lines be drawn to the circumference —

1. *The greatest of these lines passes through the centre.*
2. *The least is opposite to the greater.*
3. *Of any two others, the one which subtends the greater angle at the centre is the greater.*

Let O be the centre of ⊙, P another point within it, and x, y lines drawn from P.



1. It is required to prove that P A $> x$.
I is a $\triangle$; ∴ $d + a > x$ (Prop. 12)
but $a = m$ ∴ $d + m > x$, i.e. P A $> x$.

2. It is required to prove that P B $< x$.
I is a $\triangle$; ∴ $d + x > a$ (Prop. 12)
but $a = d + e$; ∴ $d + x > d + e$
∴ $x > e$, i.e P B $< x$.

3. If $\alpha > \beta$.
It is required to prove that $x > y$.
In $\triangle$s I and II $\begin{cases} a = b \\ d \text{ is common} \\ \alpha > \beta \end{cases}$
∴ $x > y$ (Prop. 15).

Proposition 73.—Theorem

If straight lines be drawn to a circle from a point outside it—

1. *The greatest is the one which passes through the centre.*
2. *The shortest is the one which when produced passes through the centre.*
3. *Of any two others, the one which subtends the greater angle at the centre is the greater.*

Let O be the centre of the ⊙ and P be a point outside it, and x and y be lines drawn from P.

1. **It is required to prove** that P A $> x$.

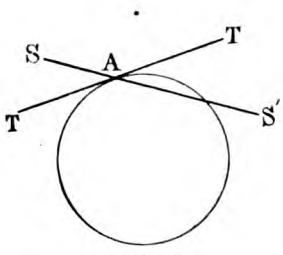


Fig. 1.

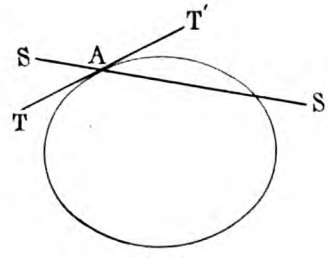


Fig. 2.

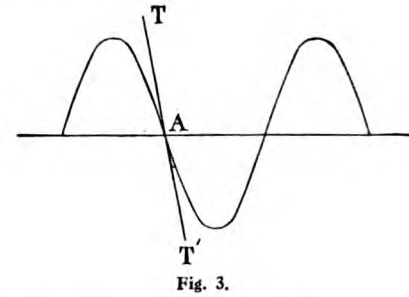
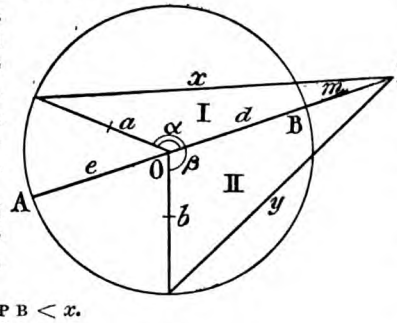


Fig. 3.

I is a $\triangle$ $\therefore a + (d + m) > x$ (Prop. 12)
but $a = e$ $\therefore e + (d + m) > x$,
i.e. P A $> x$

2. It is required to prove that P B $< x$.

I is a $\triangle$; $\therefore a + x > d + m$ (Prop. 12)
but $a = d$
$\therefore d + x > d + m$
$\therefore x > m$,
i.e. P B $< x$.



3. If $\alpha > \beta$

It is required prove that $x > y$

In $\triangle$s I and II $\begin{cases} a = b \\ d + m \text{ is common} \\ \alpha > \beta \end{cases}$

$\therefore x > y$ (Prop. 15).

Consider the curves shown in the four diagrams at the top of the page. In each of the figures a straight line T A T′ is drawn which **touches** the curve and which is called a **tangent**, and the point where it touches the curve is called the **point of contact.**

The straight line S A S′ in Fig. 1 cutting the circle in two points is called a **secant.**

We must endeavour to find some definition of a tangent which will distinguish it from a secant.

In Figs. 1 and 2 we see that the tangent lies wholly on one side of the curve, whereas the secant not only cuts it in two points, but also crosses the curve. But in Fig. 3 the tangent crosses from one side of the curve to another, and in Fig. 4 it touches the curve in one place but cuts it in others.

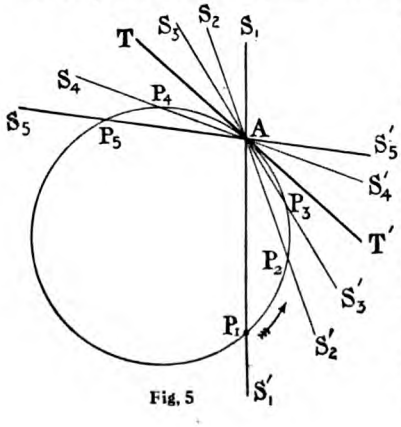


Fig. 5

We may arrive at a satisfactory definition of a tangent by considering it as a limiting position of a secant.

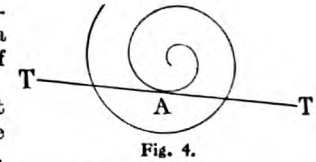


Fig. 4.

Draw the secant S_1 A S_1', cutting the ⊙ at A and P_1. Now suppose P_1 to move along the curve counter-clockwise and the secant to revolve round the fixed point A. Then when P_1 has reached the position P_2, the secant will be in the position S_2 A S_2'.

If we continue thus, the point P will ultimately reach the point A, and the secant will become the tangent T A T′ which comes in contact with the ⊙ at the point A. (Fig. 5.)

If we continue the process of rotation about A the secant will take up the successive positions S_4 S_4', S_5 S_5', etc.

Thus we see that a tangent is **the limiting position of a secant** passing through a point on the circumference of a circle, when the other point in which the secant cuts the circle coincides with the first point.

Two curves are said to touch one another at a point when they have a common tangent at that point.

They are said to touch **externally** (Fig. 6) when they lie on **opposite sides** of their common tangent, and to touch **internally** (Fig. 7) when they lie **on the same side** of their common tangent.

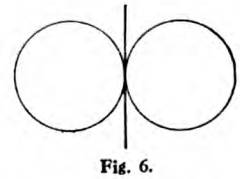


Fig. 6.

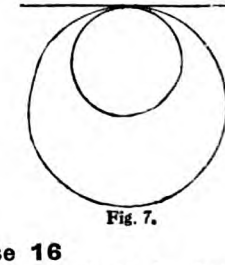


Fig. 7.

Exercise 16

(1) Through a given point draw a chord of a given circle equal to a given length.

(2) Describe a circle of given radius to touch two given intersecting straight lines.

(3) Describe a circle about a given rectangle.

(4) With a given centre describe a circle cutting another circle at the ends of a diameter.

(5) In a right-angled triangle A B C of which C is the right angle, C D is drawn perpendicular to A B, meeting it at D; prove that the line C B is a tangent to the circle described round triangle C A D.

M. A. L.

Continued from page 306.

ART AND MUSIC:

Contributors **:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant)**

MUSIC.—III

SOUND is the sensation produced in our brain by the knocking on the drum of the ear of the minute particles of which the air is composed.

When you throw a stone into a pond the stone forcibly displaces a certain quantity of water, pushing the particles away. These communicate the shock to their neighbours, and a wave of surface vibrations ripples out, ever so far. This is an approximation to what happens in the case of a shock given to the air. The particles, suddenly displaced, knock against each other—as a mass of marbles laid out close together on a table would do if pushed at the centre; and if you are near enough to be within range of the force of the vibrations you hear a sound—anything from a tick to a loud knock, according to the force and suddenness of the disturbance.

When a sparrow, suddenly alarmed, rises from the ground and flies away, its wings make only a flutter; but when a "humming-bee" flies from flower to flower, you hear a musical note. This difference in the character of the sounds is caused by the greater rapidity of the vibrations of the wings of the bee, and by certain qualities of our organs of hearing.

How Musical Sounds Occur

When the shocks given to the air reach our ear slowly—not more than sixteen to twenty a second—we hear only single sounds. If the taps, or shocks, come more rapidly and quite regularly, we hear a musical note, which is low or high according to the rapidity of the vibrations of the air. Thirty-eight thousand vibrations per second produce the highest sounds of which the ear can judge.

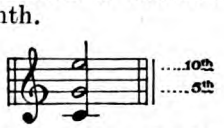
The bee's wings, when the bee is in full flight, make about 400 beats or swings per second. We do not know this through anyone having counted the "beats," but because the sound or note produced by the movement of the bee's wings—or any other note—can be imitated by instruments which register the vibrations of a fixed metal tongue set in motion by a revolving toothed wheel. In this way the number of vibrations required for any note can be determined.

At some future time we will go into the manner in which our scale of twelve equal half-tones was developed; but it seems here the place to point out a remarkable parallel between light and musical sound.

Composite Character of Notes

Just as a ray of white light is composed of three colours, as can be shown by passing the ray through a glass prism, so a musical note is composed of three tones, and both the ray and the note are produced by different affections of the same medium—the air.

Every single musical sound is composed of its fundamental or foundation note its fifth, and tenth.

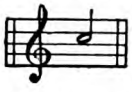


The foundation note C with its fifth G, and tenth E, together constitute the note C. Just as a ray of white light is composed of three colours, so a musical note is composed of three tones.

Now that we know what causes a musical sound—viz. a rhythmic succession of rapid air beats on the drum of the ear—we want to account for the difference in the character of the sounds that we hear.

The pitch—that is, the low tone or high tone of a note—depends on the frequency of the vibrations; the "intensity"—i.e. the loudness or softness—depends upon what is called the "amplitude" of the vibrations. If the bee's wings were much larger, and were moved with equal velocity, the note

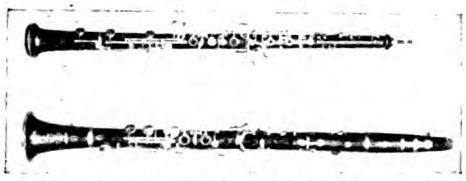
would be correspondingly louder. In the pianoforte a certain length of stretched wire, struck by the hammer, makes the note C.



You can have a soft, gentle C by a light touch on the key, or a loud note by giving the key a harder blow; but you cannot, of course, get a different note, because the property of that certain length of tightly stretched string is to vibrate with a certain frequency. You may increase the "amplitude" of the vibrations of the wire, but you cannot increase their frequency.

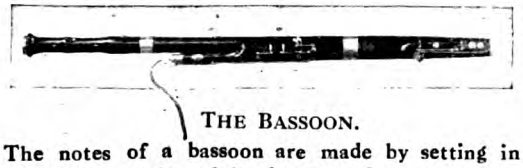
A musical sound has another quality besides "pitch" and loudness or softness. This other quality is called "timbre," or colour. There are some things in connection with "timbre" that are still unsolved; but in the main this quality which stamps, or distinguishes two sounds of the same pitch and intensity depends upon the nature and shape of the instrument employed to set up the necessary movements of the air.

There are three classes of musical instruments — wind instruments, stringed instruments, and those in which the essential part is a stretched membrane (drums, tambourines, etc.). Wind instruments include whistles, the flute, clarinet, oboe, bassoon, saxophone, trumpet, cornet, horn, trombone, euphonium, and the big bass tubas, and all instruments blown by bellows from the organ downwards.



OBOE (top), AND CLARINET (bottom). The keys or holes in the tube of the oboe enable the player to vary the length of the air column; the fact that it has only a single reed accounts largely for the clarinet's distinctive sound.

The way the sound is produced in these various instruments differs; but its main principle is to set in rapid motion a column of air enclosed in a tube. The column has to be shortened or lengthened to alter the pitch of the note.



THE BASSOON. The notes of a bassoon are made by setting in vibration two "reeds" placed surface to surface in an embouchure.

In stringed instruments the principle is the stretching of a string or strings across a sounding board chamber, or box, and the vibration of the strings by means of a bow as in the instruments of the fiddle class; by percussion, as in a piano; or by twanging, as in the harp.

What we might call the "natural history" of each class or type of the instruments of the great orchestra—and these include the organ, which some musicians designate the King of Instruments—would furnish material for interesting volumes; and none more than the family of reed instruments belonging to what is known as the "wood wind" of the orchestra. The reeds of the "wood wind" are the clarinet, the oboe, and the bassoon.

Blowing on a blade of grass; the principle of all reed instruments.

When a schoolboy makes a musical sound by blowing upon a blade of grass held tightly between the joints of his thumbs, he imitates the manner in which all reed instruments are made to "speak." The boy also illustrates the way in which the human voice is produced by means of the Vocal Chords.

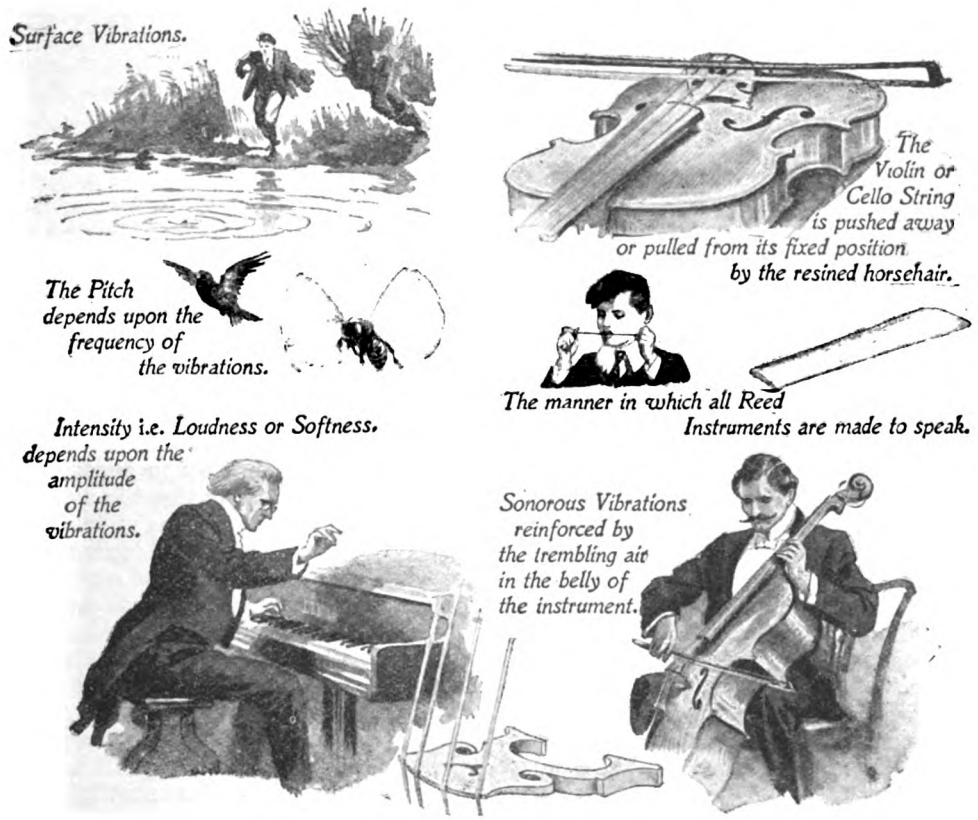
The vocal chords are two little elastic membranous strips, or ligaments, stretched across the larynx, the cartilages and bones of which form the slightly expanded part of the throat called Adam's apple. By means of the lungs—acting like bellows—wind is sent through the larynx; and the vocal chords being, by an effort of will, drawn into position, the current of air from the lungs gives them a tremulous motion, which is communicated to the air in the chambers of the pharynx, the mouth, and the nasal passages.

The vocal chords are only about three-quarters of an inch long in a man and half an inch, or slightly over, in a girl or a young woman, but the degrees of tension which a cultivated singer can apply to these chords or "reeds" will enable them to make some hundreds of notes within the compass of their lowest and highest pitch.

The difference of "timbre" in men's and women's voices is due to the lining and condition of the larynx.

Now the notes of a bassoon and an oboe are also made by setting in vibration two "vocal chords." These are two reeds, or

flat, thin pieces of cane, placed surface to surface, and fixed in an embouchure. But instead of altering the reeds, and at the same time shortening or lengthening the column of air in the air passage, as is done in singing, the player on the wood instrument modifies the vibrations of his reeds by means of his lips; and by his fingers on the keys or holes in the tube of the bassoon or oboe, modifies the length of the air column. It is the principle of the finger of one hand, draw it smartly between the thumb and finger of the other hand. A musical note is produced. Rapid vibrations of the flesh of the thumb and finger have been set up, by passing over them a multitude of particles of silk thread. The thumb and finger were squeezing the ribbon, and as the threads passed, the flesh sprang back into the furrows, a tremor being thus caused in the surrounding air, which was conveyed as sound vibrations to the ear.



SOUND

is the sensation produced in the brain by the knocking on the drum of the ear of the minute particles of which the air is composed.

boy's tin whistle in this last respect. The clarinet's distinctive sound is due principally to its having a single reed.

In the flute the sound is produced by directing a current of air on to the edge of an embouchure.

The actual process of setting up a fluttering or tremulousness of the air enclosed in a tube or chamber, to the material of which also a trembling of its particles is imparted, we can illustrate in a simple manner.

We will take half a yard or so of ribbon, and holding it tightly by the thumb and

Here we have a parallel to the manner in which the lips act upon "reeds."

We have now no difficulty in understanding the production of musical notes from stringed instruments played by a bow. The violin or 'cello string is pushed away or pulled from its fixed position by the resined horse-hair, and wanting all the time to spring back, trembles rapidly between each particle of resin. Sonorous vibrations are thus caused, which are reinforced by the trembling of the air in the body of the instrument imparted through the wood. H. G.

Continued from page 312

BUSINESS AND COMMERCE

Contributors:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).

COMMERCIAL TRAINING.—XIII

On all Bills of Acceptances three days' grace are allowed by banking custom. A bill falling due on Good Friday, Christmas Day or Sunday must be presented and paid on the previous day on which banking business is conducted. Bills falling due on Bank Holidays, however, should not be presented until the following day.

It must be clearly understood that bankers will only accept trade bills drawn strictly to meet the charges for goods delivered or value received. What are known as "Accommodation Bills," drawn for the purpose of raising money, are not discounted.

Of course, it is not necessary for a bill to be discounted. In the case we discussed on p. 308, B might have been a business man of substance, not in need of the ready money at all. Had this been the position, B would have placed A's bill in his safe and entered particulars of it in his "Bills Receivable" book. Then, on the due date, he would have paid it into his bank for collection in the ordinary way, just as he would have deposited an everyday cheque.

Facilities Afforded by Bankers

Bankers, again, will accept from customers, free of charge, and be responsible for, certain valuable property of their customers. Thus, share certificates, insurance policies, deeds, documents, plate or jewellery may be lodged with a banker and placed in his strong room, and many people deposit their wills with their bankers for security.

Then, again, presuming one is going abroad, or to some distant town, and that on arrival a certain sum of money will be required, it is quite in order to arrange for the money to be sent through one's bankers, receiving in exchange for the cash an order upon a bank at the particular place. In connection with places abroad this order would be a Letter of Credit, but for banks in this country a banker's draft would be sufficient.

It sometimes occurs that with certain fixed annual payments that have to be made, a bank customer gives a definite order to his bank for these payments to be made. This custom is frequently followed in the case of subscriptions to clubs, institutions, etc. In the same way, customers holding stocks and shares may arrange for the dividends or interest as they accrue to be paid direct into the bank.

Joint Accounts

With some businesses the banking account of the firm or company is subdivided, or two or more accounts are kept in use. Thus, a large publishing house might have a Business Account, a Literary Account, an Advertising Account, and so on. In such instances cheques would be particularly marked with the name of the account from which the proceeds to meet them were to be drawn. It happens, too, that an individual customer may have an A and B account at one branch of a bank for the purposes of his business, and here there would be necessity for specifying upon cheques, and also when paying in, to which account the amount in question referred.

In all such cases the banker, without some definite instructions, could not take funds from one account to balance a deficiency in the other; when two accounts are kept by one individual they are treated precisely as if they were the separate accounts of two customers.

Joint banking accounts are quite common —i.e. accounts standing in the names of two or more people. In opening such an account it will be necessary for written instructions to be given to the bank manager stating clearly whether each or all of the parties concerned possess the right to sign cheques or whether only one of them may sign. In such cases, too, it is customary to make

some provision for the disposal of the funds in the event of one of the parties dying, so that the position of the survivor or survivors may be made perfectly plain.

When opening an account in the name of a limited liability company, registered under the Acts, it is usual for the bank to require the production of the Articles of Association of the company, its Certificate of Incorporation, and also an official copy of the resolution passed at a meeting of the Board of Directors concerning the particular banking account. There will also be required specimens of the signatures of the directors and secretary or cashier or other persons authorised to sign cheques or to make endorsements.

"Stopping" a Cheque

A cheque that has been drawn and dispatched, but which the drawer decides later, for some reason or other, is not to be paid, may be "stopped," or payment of it countermanded. Effect is given to this wish by furnishing the bankers with particulars of the cheque and instructing them not to pay it. It is an interesting point that at law a banker who meets a cheque after receiving instructions for it to be stopped is actually liable for the amount of the cheque.

As another point of interest to all who have to do with banks, the death of a customer instantly closes his account.

When one person owes another money the creditor may obtain legal authority for distraining the goods of the debtor. In the same way a bank balance may not be touched without the authority of a court, and the usual process is the obtaining of a garnishee order. The point here is that a creditor, having obtained a judgment of the court against a debtor, may discover that the latter possesses a current account at a certain bank containing sufficient funds to meet the charges in dispute. In such a case, the creditor may obtain a garnishee order requiring the bank to pay the amount of its customer's balance into court.

Students of banking practice should also bear in mind that if an account with a bank is allowed to remain for six years without a single transaction taking place, or any form of acknowledgment being made concerning it, the balance becomes at law the absolute property of the banker.

It sometimes happens that a person is appointed to act for another in the matter of the signing of cheques. Thus, a private secretary may be permitted to sign for his employer, a clerk for a principal, or a wife for a husband. In such cases a letter of authority must be sent to the bank, or a power of attorney be executed; and it is customary for such an "agent" to write the principal's signature, but to place before it "per pro," or "for," or "on behalf of," and then to sign his own name afterwards.

Now it would be only natural for the novice in banking matters to inquire precisely how all the millions of cheques that are issued are dealt with, how a collecting bank in London obtains the money from a paying bank in Leicester, for instance.

As a matter of fact, the handling of the daily cheques of the country is one of the most wonderful undertakings of our commercial and business world, especially when one considers the millions of pounds involved in all kinds of varying amounts.

It is the Bankers' Clearing House that attends to all these matters, and practically all banks belong to this institution and come into the field which it covers with its operations. Roughly speaking, if you, A, draw a cheque on the Cranborough Branch of the London and Middlesex Bank and post it to B, who pays it into the Guildton Branch of the Surrey and Metropolitan Bank, the cheque in due course comes to your particular bank to be cleared. But your bankers do not in practice take from their till the necessary amount in cash or notes and hand it to the representatives of B's bankers, for such a proceeding would not be possible with the innumerable daily transactions that take place in the banking world.

Bankers' Clearing House

What happens is that all the branches of the various Metropolitan banks pass along the cleared cheques to their respective head offices every day. In the case of country banks they have agents in the Metropolis, in most cases also the head offices of the big joint-stock banks, and the country cheques are remitted to these agents.

At the appointed time the clerks from each of these head offices and agencies meet at the Bankers' Clearing House for the purpose of exchanging cheques drawn upon them respectively, and also those receivable by them, and in due course a settlement is arrived at. It follows naturally that at the close of the many transactions one bank will have received more than it has paid, and another bank the reverse, and so on. The clerk of each concern, therefore, totals what he has handed to each other clerk, and what the other clerks have paid to him. The balance due on either side is actually settled through an account at the Clearing House. A. B.

CHOOSING A CAREER.—XIV

The Civil Service.—(*Concluded from p.* 310)

QUITE one of the largest and most important branches of the Civil Service is that represented by the departments of **Customs** and **Excise,** which for some years past have been amalgamated.

So far as the clerical staff at headquarters is concerned, it consists mainly of Civil Service clerks, details of which have been given in former lessons in this series. In the general service, however, there are officers, inspectors, surveyors and collectors; besides a large staff of waterguard and preventive officers, who have to undertake the duties of the watching, searching and general handling of ships from which customs duty is to be collected.

In the Waterguard and Preventive Department, the lowest grade is that of boatman, and the highest that of inspector. There are also assistant-inspectors, preventive surveyors and chief preventive officers.

Those who wish to become boatmen in this service must first of all obtain the influence of a Member of Parliament to secure for them the necessary nomination. After the nomination there comes an examination, the fee for which is half a crown, and the subjects reading from type and from manuscripts, arithmetic (including the first four rules, with the tables of measures and weights) and writing from dictation.

As regards the General Staff of the Customs and Excise, which is in every way distinct from the Waterguard and Preventive Staff, it is recruited from its outdoor class; and in this service the beginner must work for at least a year on the outdoor staff before he may apply for a post indoors; and even then he may not claim such a post as a definite right.

To attain to the post of surveyor, there are held among the officers at intervals competitive examinations, the subjects of which embrace practical departmental details. Beyond the surveyor grade there are second-class inspectors and collectors and those of the first class.

Right through this service officers are liable to be transferred at short notice from one office or station to another. The working hours are normally 48 per week, whether worked by day or night; and there is also a system of overtime payments. In this section of the Civil Service officers are usually called upon to retire at the age of 61 years.

Excise officers are concerned with the collection of licence and excise duties, the examination of manufactured articles liable to duty, and some part of the work of supervising Old Age Pensions and the National Health Insurance.

Much of the duty of the above-mentioned classes is carried out at Somerset House, London, where many officials of the Inland Revenue department also have their offices. Their grades include Surveyorships of Taxes, Estate Duty Clerkships and others recruited from the various aforementioned classes. The collection of Income Tax, however, devolves to a great extent upon officers of the Excise branch.

Another department is the Government Laboratory, the work of which includes the analysis of many excisable articles, the testing of tobacco and so on. Stores supplied to Government departments are checked here, and much of the important analysis performed under the Food and Drugs Acts.

It goes without saying that those who aspire to a post in the Government Laboratory must have a sound knowledge of chemistry, both analytical and theoretical, and candidates are called upon to show the length of time they have given to the study of the subject; what degrees, if any, they possess; and whether they are either Associates or Fellows of the Institute of Chemistry.

Applicants for posts should communicate with the *Government Chemist, The Government Laboratory,* 13 *Clement's Inn Passage, London, W.C.*2.

Turning to another branch of the Civil Service, there are in connection with the **Patent Office** various Examinerships. The actual work is concerned with the multifarious drawings, plans and documents submitted to the Patent Office by inventors and others who apply for patents.

In connection with the **Labour Exchanges,** and also with **Unemployment Insurance,** there are openings for two classes of clerks, of higher and lower grades. The subjects of the examination include composition in English, handwriting, arithmetic, spelling and the copying of manuscripts. A further class in precisely the same connection is that of Clerk Messengerships. Here the examination embraces spelling, arithmetic, handwriting and copying MSS.

In the service of **Trinity House,** the department that cares for our lighthouses, lightships, buoys and such matters, second-class clerks and lower-grade clerks are

employed. There is also a class of extra clerks.

With the exception of the Post Office, we have run through the entire list of those Civil Service berths that are open to the average man or woman who can with a hope of success face the examination specified; who can procure the required nomination; or both, as the case may be. We do not claim to have covered each individual appointment, for there are some openings in which vacancies only occur once or twice during a lifetime, and others where there are only one or two officials in a grade by themselves.

It is naturally beyond the scope of these articles to offer hints and guidance as to the actual examinations to be faced, but point may be made of the necessity of paying the utmost attention to the subjects of the various papers set; and not to enter the examination room without having first most carefully studied the syllabus and prepared in every possible way for the ordeal. It is advisable not to work right up to the night before the examination. Nothing could be more detrimental to success than a weary, jaded mind. The course of subjects should be carefully mastered and not "crammed" at the last moment, especially as it is a question of obtaining a high place on the list and not of merely passing a required test.

It should be remembered, also, that the State is an excellent master; and that for every vacancy in the Civil Service there is the keenest competition among abundant candidates.

It may be mentioned again, in conclusion, that many of the previous examination papers, together with practical hints for candidates, appear in the "Civil Service Year-Book," which is published in the early part of each year by *The Clerkenwell Press, Ltd., Clerkenwell Road, London, E.C.*

Attention is called also to the fact that most of the examinations, even those held after nomination, are conducted by the Civil Service Commission; and much useful information may be obtained by writing about a particular class or subject to the *Secretary of the Commission, Burlington Gardens, London, W.*1. At the same time, only questions of the most open character may be put.

We come now to another class of Civil Servants, quite important to the community at large, but on a slightly different plane from any of those in the above grades. This particular class embraces the prison warders; or, in official terms, the **Male Subordinate Staff** of the **Prisons Service** of England. The duties lie in prisons, Borstal institutions and State Inebriate Reformatories.

Generally speaking, candidates of average stature between 24 and 36 years of age are those selected. A searching medical examination has to be passed, and men with a knowledge of some trade or calling are most likely to be engaged, in order that they may impart their knowledge to convicts.

The most careful inquiry is made into the character and antecedents of every applicant before he receives the required nomination.

The test embraces reading, writing and simple arithmetic; and there is an entrance fee of 2s. 6d. On joining the service, a warder is placed for a period of four months under instruction, and for the first year of his service is on probation.

It should be understood that there is a Prison Commission for England and Wales; one for Scotland; and a Prisons Board for Ireland; three separate and distinct bodies.

So far as England and Wales are concerned, the address to which candidates should communicate is: "*The Prison Commissioners, Home Office, Whitehall, London, S.W.*1," the envelope to be marked in the lower left-hand corner, "*Staff Branch.*" In the case of Scottish applicants, they should address their envelopes to "*The Prison Commissioners, Rutland Square, Edinburgh*"; and when the schedule has been fully filled in it should be lodged with the governor of the prison nearest to the applicant's home, together with a recent photograph.

The next step is for the candidate to be examined by the Medical Officer of the Prison. If he is reported to be fit, his application is sent on to Edinburgh; and, in due course, he will receive official intimation as to whether his case can be entertained or otherwise.

The minimum height for warders in Scotland is 5 feet 8 inches, and the age limit from 22 to 40 years of age. There is an examination in elementary arithmetic, handwriting, spelling and the copying of manuscript; and candidates themselves are called upon to pay their fares to and from the examination and also a small fee for the educational test.

House accommodation, or an allowance in lieu, uniform and a grant for boots are provided for the warders.

The Prisons Board for Ireland has offices in Dublin; and candidates should write to the Secretary for a form of application.

A. C. M.

BOOK-KEEPING.—X

For Bookkeeping purposes Bills may be divided into two classes—**Bills Receivable and Bills Payable.** For the present the student is recommended to pass Bill transactions through the Journal. This will enable him in the simplest way to get a clear grasp of their treatment. In actual business, however, special Bill books are used, and these will be explained later.

A Bill Receivable is one which represents value to be received, whilst a Bill Payable is one which indicates that a payment of the amount must be made at some subsequent date.

Bill Transactions

Supposing Thomas Brown draws a Bill on William Terry, such Bill will from Thomas Brown's point of view be a Bill Receivable, whilst William Terry will look upon it as a Bill Payable. In the first case it represents money to be received, whilst in the latter it represents money to be paid.

Thomas Brown, having received William Terry's acceptance, will debit Bills Receivable and credit William Terry's personal account. The effect is the same as if cash had been received from William Terry in payment of his indebtedness. Had cash been received, his personal account would have been credited by cash, but as a Bill has been received his account will be credited by B/R.

If a trader draws a Bill on another person and it is accepted, it is to the trader a Bill Receivable. If the trader "accepts" a Bill (i.e. undertakes to pay it according to its terms and tenor), then it is in his books treated as a Bill Payable, as at a subsequent date it will be necessary to provide the cash with which to meet it.

A Bill may have passed through the hands of several persons and finally be paid to Robert Hargreaves in settlement of an account. Robert Hargreaves will treat such a Bill as a Bill Receivable, his Bills Receivable account will be debited, and the person from whom he received it will be credited. Supposing Robert Hargreaves pays away the same Bill to Hubert Patrick in payment of an account, Hubert Patrick's personal account will be debited and B/R account will be credited.

In order to gain a clear conception of the treatment of Bills Receivable and Payable, the student should turn to the table on p. 376.

Bills of Exchange in the hands of a trader may be dealt with in various ways, e.g.

(1) He may pass a Bill on to another person just as he would pay away cash.

(2) He may keep it until the due date and then pay it into his Bank for collection, just as he would pay in a cheque.

(3) He may sell it to his Banker or to a Bill Broker. In this case, instead of receiving its face value, an amount would be deducted (called "discount") representing the charge for the privilege of using the money till the due date of the Bill.

The treatment of (1) has already been explained. The following examples will make (2) and (3) more easily understood.

Journal Entries

Supposing William Fell has bought goods from you to the value of £60, and he afterwards accepts your draft for that amount payable at one month's date. His personal account would first of all be debited with £60, and afterwards be credited by a Bill Receivable for the same amount, thus closing the account. The B/R account was debited at the time when William Fell's personal account was credited, and if on the due date the Bill is paid into the Bank an entry will be made on the debit side of the Cash Book as below.

When this item is posted to the credit of B/R account that account will be closed. The Bill Receivable has, in fact, been changed into cash standing to your credit in the Bank.

To take another case: you have purchased from B. Brady goods to the value of £78, and have given him your acceptance for that amount. First of all Brady's personal

Dr. CASH BOOK *Cr.*

		Disct.	*Cash*	*Bank*			*Disct.*	*Cash*	*Bank*
				£ s. d.					
To B/R				60 – –					

account is credited with the value of the goods and afterwards debited with the Bill Payable. In this way the account is closed. There is, however, the sum of £78 standing to the credit of B/P account. On the due date of the Bill you receive a notification from the Bank that it has been presented by Brady and duly honoured, that is to say, the Bank has paid to Brady the sum named in the Bill.

The Bank account in your Cash Book must now be credited, as follows :—

" James Garlett met his acceptance for £310 under a rebate of £10."

As the word " rebate " in this case means a cash discount allowed for payment before the Bill is due, it is evident that Garlett met his Bill before maturity.

The entry would be made accordingly.

" Paid off my acceptance for £150 under rebate of £1 10s."

This transaction would be recorded in the Cash Book by a debit entry, " To Rebate on Bills," of £1 10s.

Dr. CASH BOOK *Cr.*

		Disct.	*Cash*	*Bank*			*Disct.*	*Cash*	*Bank*		
									£	*s.*	*d.*
					By B/P				78	–	–

The posting of this item to the debit of B/P will close the B/P account.

It is customary for Bills to be discounted, rather than kept by the drawer until the due date. This is usually done through the Bank and the transaction recorded in the Cash Book. As already explained, the Bank will make a charge for crediting the money before the Bill is due. This charge (called " discount ") takes the form of a deduction from the face value of the Bill. For example, a Bill for £250, payable at three months' date, may be discounted at the end of the first month. The holder would not expect to receive the full £250. He would probably be credited by the Bank with, say, £247, the remaining £3 representing the Banker's charge for the use of the money. The following examples will make this procedure clear :—

" Discounted Eli Brown's acceptance for £200 and was charged discount £2 10s."

The Cash Book entry for this would be as follows :—

Definitions of Terms

Hire Purchase Agreement : This is an agreement whereby a person buys goods and takes possession of them, paying by instalments. The property in the goods does not pass to the purchaser until after the payment of the final instalment.

Account Sales : A document sent by an Agent showing the result of sales effected on behalf of his Principal. It is similar in form to an Invoice, but in an Account Sales the various charges paid, such as packing, carriage, etc., are deducted in order to determine the net proceeds.

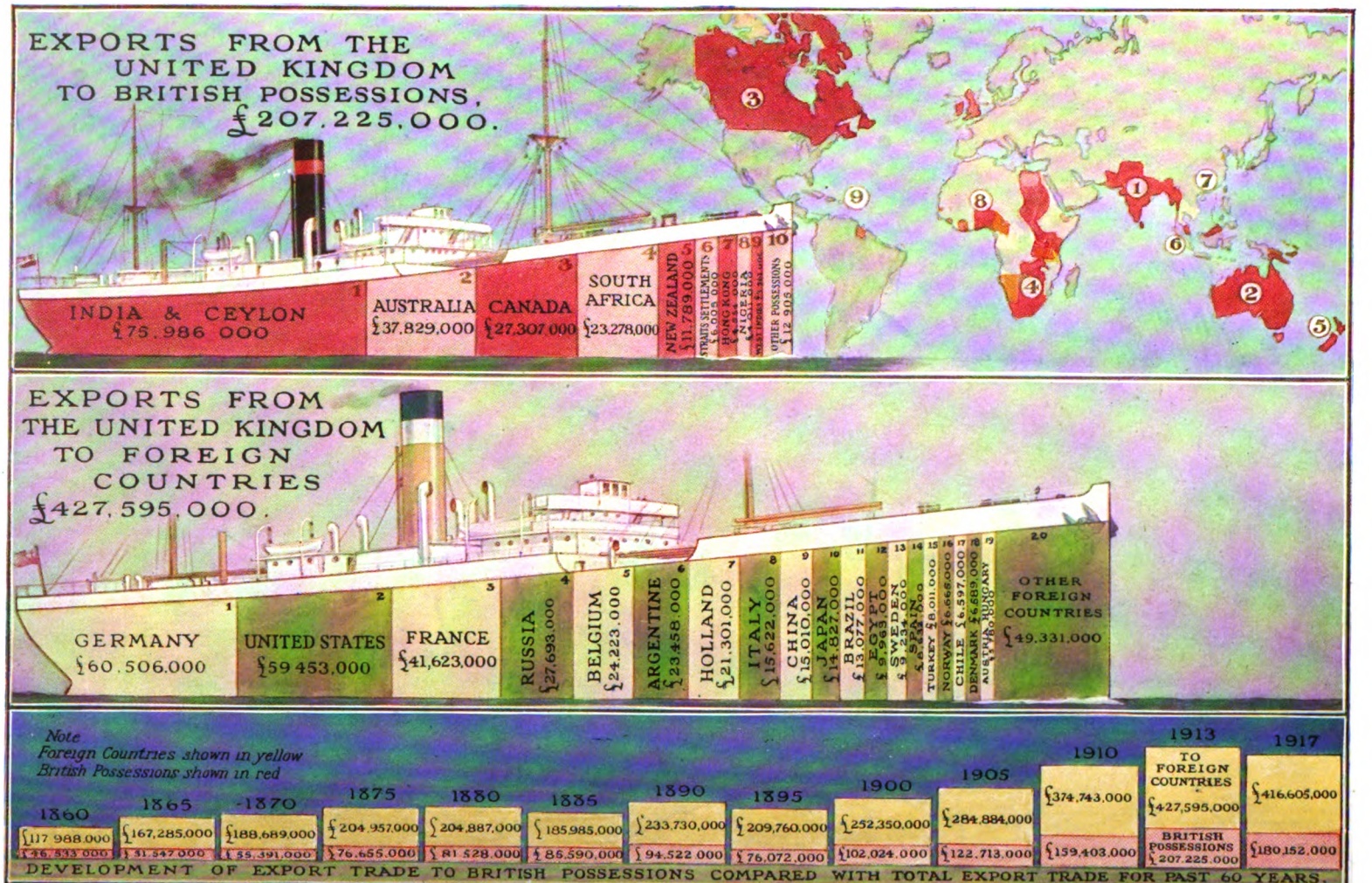
Documentary Bills : These are Bills of Exchange to which are attached various documents of title to the goods, such as Bills of Lading, Policy of Insurance, etc., these being the shipping documents referring to the goods in payment for which the particular Bill is drawn. They are generally attached to Foreign Bills, and act as security in the event of the Bill being dishonoured.

Dr. CASH BOOK *Cr.*

		Disct.	*Cash*	*Bank*				*Disct.*	*Cash*	*Bank*		
				£	*s.*	*d.*				£	*s.*	*d.*
To B/R				200	–	–	By Discount on B/R			2	10	

No.	*Transaction.*	*Kind of Bill.*	*Journal Entry.*	£ *s.* *d.*	£ *s.* *d.*
1	You draw a Bill of £300 on Arthur Anderson, which he accepts.	Bill Receivable (B/R).	B/R Dr. To Arthur Anderson	300 – –	300 – –
2	Benjamin Barclay draws a Bill on you for £90, which you accept.	Bill Payable (B/P).	Benjamin Barclay Dr. To B/P	90 – –	90 – –
3	You receive an acceptance for £450 from Messrs. Carter.	Bill Receivable (B/R).	B/R Dr. To Messrs. Carter	450 – –	450 – –
4	You forward an acceptance (£99) to Major Dawkins.	Bill Payable (B/P).	Major Dawkins Dr. To B/P	99 – –	99 – –
5	You receive a Bill but do not accept it.	Draft.	Nil		
6	You send a Bill which is returned not accepted.	Draft.	Nil		
7	Arthur Benson hands you Caldwell's acceptance to him for £75.	Bill Receivable (B/R).	B/R Dr. To Arthur Benson	75 – –	75 – –
8	Edward Fearnley draws upon you for £106 in favour of George Harrison, and you accept the draft.	Bill Payable (B/P).	Edward Fearnley Dr. To B/P	106 – –	106 – –
9	Forwarded to George Harrison the acceptance given to me by T. Ingram, value £98.	Bill Receivable (B/R).	George Harrison Dr. To B/R	98 – –	98 – –
10	Received acceptance from J. Lindsay for £95, allowing him £5 discount.	Bill Receivable (B/R).	B/R Dr. Discount Dr. To J. Lindsay	95 – – 5 – –	100 – –
11	Accepted M. Morrison's draft for £68, being allowed £2 discount.	Bill Payable (B/P).	M. Morrison Dr. To B/P To Discount	70 – –	68 – – 2 – –
12	Received acceptance from Nathan Oakwood for £50, charging him also Interest £1 10s.	Bill Receivable (B/R).	B/R Dr. To Nathan Oakwood Nathan Oakwood Dr. To Interest	50 – – 1 10 –	50 – – 1 10 –
13	Accepted Robert Richardson's draft for £300, being charged in addition Interest £15.	Bill Payable.	Robert Richardson Dr. To B/P Interest Dr. To Robert Richardson	300 – – 15 – –	300 – – 15 – –

F. H.



THE UNITED KINGDOM, LTD.

A pictorial diagram showing the extent and development of the export business of this old established firm, with its forty odd millions of shareholders.

Continued from page 316.

ENGLISH LANGUAGE AND LITERATURE:

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THE LIFE AND WORKS OF JOHN MILTON

THE lives of the two greatest English poets, Shakespeare and Milton, overlapped by eight years, and it is possible that the child Milton, living at his father's house in Bread Street, off Cheapside, may have seen Shakespeare when he came up to London from Stratford, in his later prosperous years, after his writing for the stage was ended, and foregathered in friendship's name at the Mermaid with Jonson, Beaumont, Drayton, and Chapman—for the Mermaid Tavern was in Bread Street.

John Milton, like Alexander Pope and Alfred Tennyson in later times, was reared to be a poet. All his early training was such as would best prepare him for writing ambitious poetry. His father, John Milton, who had come to London on being cast off by his Catholic family for accepting Protestantism, was a man of education and taste, and, as a scrivener, acquired "a plentiful estate," which he used first to educate his children thoroughly.

At Cambridge

John, the elder boy, born on December 9th 1608, had sound private tuition before going to St. Paul's School at the age of twelve, and was a fine scholar when he became a Cambridge student at the age of sixteen. At Cambridge he stayed seven years. Before he left, in 1632, his younger brother, Christopher—afterwards Sir Christopher, and a judge—was entered as a student.

At first John Milton was not popular in Cambridge. Already he had fixed his mind on writing poetry which the world "would not willingly let die," and had determined that the life of the true poet should be itself a poem, pure and ideal. No man ever fulfilled more faithfully than he, to his life's end, the vows of strict obedience to conscience made in the freshness of boyhood. Before he left the University he had won universal respect, and established a position as a man apart, deserving "choice regard."

Early Writings

Milton's writings while he was at the University were few and brief. Among them are the *Ode on the Morning of Christ's Nativity;* lines on *Time;* lines on *Shakespeare,* printed in the second folio edition of Shakespeare's Works in 1632, and the first poem by Milton that reached print; *At a Solemn Music; On Arriving at the Age of Twenty-three;* and, probably, the *Song on a May Morning* and the *Sonnet on the Nightingale.*

Unquestionably the Nativity Ode remains the greatest "first poem" in our literature. It may be imitative, with its long rolling Spenserian swell; it may be weakened by the "conceits" common to nearly all the poetry of that generation; but it has a new and distinctive charm, and brings majesty and dignity to the poetry of religion, with a grace unparalleled.

For nearly six years after he left Cambridge—that is, until he was about thirty years old—Milton continued the kind of quiet preparation for a great poet's career which he had begun at the University. His father had retired from business to live in comfortable leisure at the South Buckinghamshire village of Horton, and was joined in that seclusion by his son. Apparently the paternal hope had been that the son would become an ornament of the Church, but Milton announced that he could not "subscribe slave," and in a Latin poem to his father he pleaded successfully, by his father's

devotion to music, for his own devotion to verse.

Life at Horton was diversified by visits to London, partly for study and partly for the enjoyment of music, which Milton, like his father, loved passionately. One of his friends at this time was Henry Lawes, a gentleman of the Royal Chapel and band, and a musical composer of mark and merit. The poet's writings at Horton were in part suggested by his life in the country, and in part by his association with Lawes.

L'Allegro and *Il Penseroso*

We know exactly how, by eye and ear and reflection, Milton revelled in country scenes, whether he saw them on bright ideal days, in a mood of mirth, as pictured in his *L'Allegro*, or mused more pensively at night, as described, with illustrations in the classical vein, in *Il Penseroso*.

For Lawes he wrote a fragment of a masque, *Arcades*, with songs for a musical setting; and, later, the most poetical of all English masques, *Comus*, which Lawes produced, supplied with melodies, and printed. Though a Puritan, Milton had more than a toleration for the stage, as it gave scope for a Shakespeare or a Ben Jonson, and he made his *Comus*, for what we should now call private theatricals, at the Earl of Bridgewater's Castle at Ludlow, an example of pure poetry slightly dramatised, with the power of chastity as a central theme.

The remaining poem written by Milton during the Horton period, his *Lycidas*, was printed in 1638, in a mixed Cambridge volume commemorating Edward King, a popular graduate, who was drowned on a voyage to Ireland. This haunting, though artificial, lament, cast in a pastoral form, played over by the loveliest imagery of the classical poets, sustained a musical grace which before had only visited our language in brief snatches.

Suddenly, leaving classical allusions, he introduces the Galilean fisherman Saint Peter, and uses him to denounce ecclesiastical corruption with a fierce scorn unlike any note sounded before, but soon to be painfully familiar in his prose pamphlets. We feel that the Puritan "with harsh din breaks the fair music" of the poet; but it marks a stage in the evolution of Milton. After another very brief interlude of preparatory rest, he will not longer be a poet, primarily, for over twenty years, but a man of affairs, a controversialist, a politician, a wanderer from the pathway of his youthful visions.

The further interlude of rest came in the form of a fifteen months' visit to the Continent. The poet's mother, of whom little is known, died in 1637, and next year his younger brother, Christopher, seems to have taken his place in the paternal home at Horton, while he sought the mental enrichment of travel.

Passing through France and Switzerland, he traversed Italy as far south as Naples. Everywhere he was received in learned society as a distinguished man of letters. This was not because his English poems were known, but because he wrote Latin and Italian poetry as freely as he wrote in his native tongue. Learning and poetical ardour were his recommendations. He was welcomed by the foreigners best worth knowing. In France he met Grotius, the Dutch founder of International Law; in Italy he interviewed the blind Galileo. But the farther he went the more he was disturbed by news of turmoil in England, and when he turned back at Naples it was because he felt it was "base to be travelling abroad at ease while his fellow countrymen were fighting at home for liberty." So, by the middle of 1639, Milton was home again. It is characteristic of the man that when abroad he not only "lived sound and untouched from all profligacy and vice," but that he should uphold his standard of purity by saying so.

A Champion of Liberty

When Milton returned to England he set up house for himself in London, started a school with his sister's sons as pupils, and began to plan the great epic which was to be the chief work of his life. But the strong feelings that had broken out in *Lycidas* reasserted themselves, and he rushed into a war of hot and violent pamphlets on religious and political questions that was destined to delay his true work for twenty years, while it carried his name throughout Europe as the literary associate of the warlike Cromwell.

The story of these twenty years is only illuminated by the love of liberty which glowed fiercely in all his writings. A few dates will cover biographical details. In 1643, the poet, a Puritan of thirty-five, went into the country and suddenly married a loyalist maiden of seventeen, who at the end of a month deserted him, but two years later came back penitent and was forgiven. In 1646 the poet's works, in English, Latin, and Italian, were first published. In 1649 Milton was appointed Latin Secretary to

the Council of State, an office he held for ten years. In 1652 he became totally blind, and during the next year his wife died, leaving him with three daughters, two of whom proved cruelly unappreciative. He married a second time, happily, in 1656; and a third time, usefully, in 1663.

His only poetical productions during the period of teaching, pamphleteering, and secretaryship were a few fine sonnets, some on personal affairs—his friends, his blindness, his sainted second wife; some on public affairs—notably a plea to Cromwell for religious freedom, and a reverberating protest against the massacre of Protestants in Piedmont.

He retained his Secretaryship until the Restoration of Charles II., which he opposed to the very last—"among the faithless faithful only he"—writing against it to within a month of its accomplishment, a proof either of extreme courage or of inability to read the signs of the times. Two years earlier than this his intimate friend Andrew Marvell had been appointed assistant secretary, though Milton continued to write the principal dispatches to foreign governments. Marvell's help, however, had lessened his responsibilities, and about 1659 he seems to have returned to the fulfilment of his earlier plans by beginning his long delayed *Paradise Lost*.

In 1660, with *Paradise Lost* partly written, Milton was placed in the gravest danger by the Restoration. His prose writings defending the execution of Charles I. were burned and he was arrested; but, probably owing to the interposition of royalist friends like Sir William Davenant, whose life he is said to have saved at an earlier date, he was allowed the benefits of the Act of Indemnity.

The remainder of his life was passed in comparative seclusion. *Paradise Lost*, finished by 1663, was published in 1667. *Paradise Regained* and *Samson Agonistes*, finished by 1667, were published in 1671. During the last seven years of his life Milton, as far as is known, wrote no verse. He died in 1674 in his sixty-sixth year. Towards the end of his life his means were lessened and his health was troublesome, but he was never poor, and in an age of licence and reaction he was held in widespread honour.

From the bust at Christ's College, Cambridge.

JOHN MILTON (1608–1674).

He lived to know that he had attained the fame foretold by his youthful dreams. Before he died about three thousand copies of his epic had been circulated, and it had taken its place as one of the world's literary masterpieces. The price arranged to be paid to him as author was twenty pounds, to be received in instalments by the time three editions of 1,500 copies each should be sold. Milton received ten pounds, and his widow compounded the remainder for eight pounds in ready money.

In his later life the sterner elements of Milton's character came to the surface. A wealth of knowledge had permanently enriched his mind with poetical allusions, and wide experience gave fullness to his thought, but the early lyrical grace of his writing was gone. With the exception of a few unimportant entries of the chorus in *Samson Agonistes* he discarded rhyme, and relied on the blank verse he had first used with

splendid mastery in *Comus*. In his hands the natural dignity of blank verse was united with a flexibility that precluded monotony, and the measure was made to meet with ease the requirements of an epic having a range of vision wider than that of any poem conceived before or since.

If we frankly accept the poet's point of view—a condition precedent to all just criticism—we must admit that the success attained is stupendous. The epic never droops from its dignity. Sometimes it rises to thrilling dramatic power; again it searches the heart by tenderest pathos.

Paradise Lost

The poet opens with the plain announcement of his subject, "man's first disobedience," and goes on to invoke the Holy Spirit to assist him in his purpose of "justifying the ways of God to man." Mention of the cause of man's transgression introduces the Apostate Angel Satan :—

Him the Almighty Power
Hurled headlong flaming from the ethereal sky,
With hideous ruin and combustion, down
To bottomless perdition, there to dwell
In adamantine chains and penal fire,
Who durst defy the Omnipotent to arms.

The return to Satan of his self-possession after rolling in the fiery gulf for nine days and nights, his consultation with Beelzebub, "one next himself in power and next in crime," his rallying of their associates till they gather on the shores of hell's burning lake, "with looks downcast and damp," begins the most majestic scene in the whole of the epic. Satan faces his faithful legions, laments their direful plight, reveals to them his future plans, and inflames them to new rebellion.

He spake; and, to confirm his words, out-flew
Millions of flaming swords, drawn from the thighs
Of mighty Cherubim. The sudden blaze
Far round illumined Hell. Highly they raged
Against the highest, and fierce with grasped arms
Clashed on their sounding shields the din of war,
Hurling defiance toward the vault of Heaven.

The First Book of the epic closes with the building, by Mulciber, of Satan's palace of Pandemonium.

The Second Book tells of the fiendish conclave where the rebel plans were settled. Moloch advises war. Belial temporises, fearing failure and annihilation.

Who would lose
Though full of pain, this intellectual being,
These thoughts that wander through eternity.

Mammon wishes for peace. At last Beelzebub supports Satan in trying to spite God by ruining man. But who is to make the journey, "through all the coasts of dark destruction," in search of the new world where, it is rumoured, God has placed man? For this dangerous adventure Satan volunteers, and, spreading "his sail-broad vans for flight," passes into "the wild abyss, the womb of Nature and perhaps her grave," until he comes within sight of Heaven, "once his native seat"—

And fast by, hanging in a golden chain
This pendent world, in bigness as a star
Of smallest magnitude close by the moon.

In the Third Book the poet takes the reader to Heaven after addressing an exalted Invocation to Light, and uttering a pitiful lament on his own blindness.

Thus with the year
Seasons return; but not to me returns
Day, or the sweet approach of even or morn,
Or sight of vernal bloom, or summer's rose,
Or flocks, or herds, or human face divine,
But cloud instead, and ever-during dark
Surrounds me, from the cheerful ways of men
Cut off.

The coming of Satan to Paradise (described in Book Four) shows Milton, again and again, in his most captivating mood. "Though bold far off and fearless," Satan almost repents his evil task :—

Me miserable! which way shall I fly
Infinite wrath and infinite despair?
Which way I fly is Hell; myself am Hell,

then, hardening his heart afresh by jealousy of mankind, created to take in bliss the place of the fallen angels :—

So farewell hope, and, with hope, farewell fear,
Farewell remorse! All good to me is lost;
Evil, be thou my Good: by thee at least
Divided empire with Heaven's King I hold.

Satan Enters Eden

Arriving, pensively and slowly, at Eden, Satan enters by overleaping the wall, and first sees many new forms of life, including man.

Saw, undelighted, all delight—all kind
Of living creatures, new to sight and strange.
Two of far nobler shape, erect and tall,
God-like erect, with native honour clad.

The poet's contrast of the sexes shows a view of inequality which runs through all his writings :—

For contemplation he and valour formed
For softness she, and sweet attractive grace.
He for God only, she for God in him.
His fair large front and eye sublime declared
Absolute rule.

Taking the shape now of one animal and then of another, Satan keeps near the pair, and overhears Adam explain to Eve that only the fruit of the Tree of Knowledge is forbidden to them. In return, Eve tells him how she awoke to life, saw her own image in a smooth lake, and " pined with vain desire " until she was led to within sight of Adam, whom she thought

> Less fair,
> Less winning, soft less amiably mild
> Than that smooth watery image.

But this admiration of herself before Adam only lasted until

> Thy gentle hand
> Seized mine; I yielded, and from that time see
> How beauty is excelled by manly grace
> And wisdom, which alone is truly fair.

Meantime, as the day declines, Uriel, who from the Sun had watched the descent of Satan to the earth, and had discovered in him " looks alien from heaven," darts down to the earth on a sunbeam, and warns Gabriel, captain of the angelic guard of Paradise,

> One of the banished crew,
> I fear, hath ventured from the Deep to raise
> New troubles.

From the picture by Ford Madox Brown.

"O MOST CHRISTIAN KING, I BESEECH AND OBTEST THEE . . . . "

Cromwell dictating, Milton translating, and Andrew Marvell transcribing (for Milton was blind) the famous dispatch regarding the Vaudois massacres (1655). Milton was appointed Latin Secretary to the Council of State in 1649, and took up his abode in a little house in Holborn, opening on Lincoln's Inn Fields.

And Gabriel promises that the intruder shall be found by the morning. Here Milton introduces his exquisite picture of night :—

> Now came still evening on, and Twilight gray
> Had in her sober livery all things clad;
> Silence accompanied; for beast and bird,
> They to their grassy couch, these to their nests
> Were slunk, all but the wakeful nightingale.
> She all night long her amorous descant song.
> Silence was pleased. Now glowed the firmament
> With living sapphires: Hesperus, that led
> The starry host, rode brightest, till the Moon,
> Rising in clouded majesty, at length
> Apparent queen, unveiled her peerless light,
> And o'er the dark her silver mantle threw.

From the picture by M. Munkacsy, exhibited at the Paris International Exhibition, 1878, and now in the Lennox Gallery, New York.

MILTON DICTATING *PARADISE LOST.*

The great epic finished in 1663 was first published in 1667, Milton as the author agreeing to accept from the publisher the sum of £20—to be received in instalments by the time that three editions each of 1,500 copies had been sold. At the time of his death in 1674 the poet had received £10; his widow then compounded the remainder for £8 in ready money.

The Miltonic idea of the true relations between husband and wife is introduced in curious preface to most exquisite verse. As they walk Eve says :—

> My author and disposer, what thou bidd'st
> Unargued I obey. So God ordains :
> God is thy law, thou mine : to know no more
> Is woman's happiest knowledge, and her praise.
> With thee conversing, I forget all time,
> All seasons, and their change : all please alike.
> Sweet is the breath of morn, her rising sweet,
> With charm of earliest birds ; pleasant the sun,
> When first on this delightful land he spreads
> His orient beams, on herb, tree, fruit, and flower,
> Glistening with dew ; fragrant the fertile earth
> After soft showers ; and sweet the coming-on
> Of grateful Evening mild ; then silent Night,
> With this her solemn bird, and this fair Moon,
> And these the gems of Heaven, her starry train :
> But neither breath of Morn, when she ascends
> With charm of earliest birds ; nor rising sun
> In this delightful land ; nor herb, fruit, flower,
> Glistening with dew ; nor fragrance after showers ;
> Nor grateful Evening mild ; nor silent Night,
> With this her solemn bird ; nor walk by moon,
> Or glittering star-light, without thee is sweet.

Gabriel and Ithuriel

Gabriel now commands Ithuriel and Zephon, two of his attendant angels, to search the garden for an Evil Spirit.

> Him there they found
> Squat like a toad, close to the ear of Eve
> Assaying by his devilish art to reach
> The organs of her fancy, and with them forge
> Illusions as he list, phantasms and dreams.
> * * *
> Him thus intent Ithuriel with his spear
> Touched lightly ; for no falsehood can endure
> Touch of celestial temper, but returns
> Of force to its own likeness. Up he starts
> Discovered and surprised.

The angels then bring the intruder to Gabriel, and at first it seems as if there would be "dreadful deeds," for,

> Satan, alarmed,
> Collecting all his might, dilated stood,
> Like Teneriffe or Atlas, unremoved ;
> His statue reached the sky, and on his crest
> Sat Horror plumed ; not wanted in his grasp
> What seemed both spear and shield.

Then, recollecting his powerlessness, he "fled murmuring." Note how the poet appeals to the imagination by the images, vast and vague, of a dream.

The Fifth Book finds Eve waking from unquiet rest and dreams of the forbidden Tree of Knowledge, but she is comforted by Adam, and they sing their morning hymn : "These are thy glorious works, Parent of good, Almighty !"

The Archangel Raphael now arrives from Heaven, and instructs Adam in the need for obedience by describing the effects of Satan's disobedience in Heaven, and the strife which ended in the rebels throwing themselves down from the verge while "eternal wrath burnt after them to the bottomless pit." This recital occupies also the Sixth Book, and, in the Seventh, the Archangel tells of the creation of the earth ; but not knowing how human life began in Eden as he was at the time,

> Bound on a voyage, uncouth and obscure,
> Far on excursion toward the gates of Hell,

Adam takes up the story, closing with a pæan in praise of Eve :—

> Greatness of mind and nobleness their seat
> Build in her loveliest, and create an awe
> About her, as a guard angelic placed.

In her presence Adam admits his weakness :

> Superior and unmoved, here only weak
> Against the charm of beauty's powerful glance.

Before taking his leave Raphael again warns his pupil of the obligation of obedience.

> Be strong ; live happy ; and love. But first of all
> Him whom to love is to obey, and keep
> His great command.

And so the preliminaries of the great drama are brought to their close.

The Fall of Man

Milton now feels, with truth, that the climax of his story is reached, and he begins his Ninth Book with a personal note telling how he has turned from slighter themes for his epic to the most heroic of all subjects, the Fall of Man, and now hopes that age may not have damped the wing of his Muse. The suggested fear is needless, for the whole of this wonderful Book vies for pre-eminence with the Second and Third Books.

Satan, who has been circling round and round, hiding in the shadow of the earth, while Raphael was in Paradise, now re-enters the garden as a mist, and next takes the form of the serpent, then a handsome creature and erect.

We are prepared for the downfall of Eve by the talk of the sinless pair before they separate in the morning for solitary duties. Milton's method is to build up interest by expectation, not by surprise. Eve wishes to work apart ; but Adam is possessed by doubt.

The wife, where danger or dishonour lurks,
Safest and seemliest by her husband stays.

Eve answers that she knows what he means, for, standing in a shady nook as she returned to their bower, " at shut of evening flowers," she overheard the Angel say that an enemy was seeking their ruin, but she never expected that Adam would doubt her firmness under temptation. Adam replies that he is actuated by love, not by distrust, and, giving way, she leaves him, followed by loving glances.

When Satan, wandering through the garden, found Eve alone, her graceful innocence " overawed his malice," and not till he had braced himself by fresh arguments could he begin the task of temptation. The approach to Eve by flattery, the guileful arguments that " too easy entrance won " to her heart, the arguments by which she deceived herself, the exultation in wrong followed by doubt, then by fear, then by jealousy lest she die and Adam wed another Eve, the determination to bring Adam also within the curse, Adam's consternation, yet instant surrender of his life to his love, a surrender in mind before he had sinned in act—are pictured with consummate skill.

Adam has no illusions. He sins in the name of fidelity to Eve. Shame, the demoralisation of the unhappy pair, nagging recriminations come later. The tragedy is complete.

Paradise Regained

The last three Books of the poem relate how the Son is sent from Heaven to pronounce doom upon the guilty pair. Meantime Sin and Death build through Chaos a road from Hell to the Earth, and become Satan's substitutes on Earth. The arch-fiend himself, on returning to Pandemonium, and boasting of his exploits, is received, in place of applause, with " a dismal universal hiss," and all his host are turned to grovelling serpents. On earth Adam and Eve become repentant, and appeal for divine mercy.

God accepts their repentance, but decrees their expulsion from Paradise, and sends the Archangel Michael to announce the sentence. The angel comforts her, and, as a further comfort to Adam, gives him a prophetic vision of the history of the world to beyond the time of Christ. But the time has come for their departure. An array of Cherubim, preceded by a blazing sword, descend on Paradise, and Michael hastens Adam and Eve away into the plain outside.

They, looking back, all the eastern side beheld
Of Paradise, so late their happy seat,
Waved over by that flaming brand ; the gate
With dreadful faces thronged and fiery arms.
Some natural tears they dropped, but wiped them soon ;
The world was all before them, where to choose
Their place of rest, and Providence their guide,
They, hand in hand, with wandering steps and slow,
Through Eden took their solitary way.

Paradise Regained is not a sequel to *Paradise Lost*, but only an expansion of the Scriptural account of the Temptation of Christ. By comparison with the greater poem its style is tame. Its Satan is not the Satan of the First Book, and indeed is not even an interesting character. But in his last poem, *Samson Agonistes*, the poet again shows his full power. Samson is not, except in barest outline, the Samson of the Bible, but a Miltonic creation, an idealistic Hebrew patriot, who has been subtly overcome by the enemy through his own folly, but redeems himself and his cause at last by a supreme sacrifice.

Samson Agonistes

In form, the poem follows the Greek dramatic model, with an accompanying chorus. In inner significance more is meant than meets the ear, for Samson is unquestionably pictured as a symbol of the Puritanism in which Milton had been bred, but which had been betrayed and humiliated under the Philistinism of the Restoration. Samson, blind, in the hands of his enemies, but unsubdued, is also a consciously drawn parallel of Milton himself. But, unlike Samson, Milton never betrayed his cause. To the end he sustained a lofty consistency resembling that of the seraph Abdiel, whom he had pictured as resisting Satan.

Among the faithless faithful only he,
Among innumerable false unmoved,
Unshaken, unseduced, unterrified,
His loyalty he kept, his love, his zeal ;
Nor number nor example with him wrought
To swerve from truth, or change his constant mind
Though single.

No one can know Milton without feeling that, despite some weaknesses, he was not only a supremely great poet, but a great man, and that Wordsworth's exalted tribute,

Thy soul was like a star that dwelt apart ;
Thou hadst a voice whose sound was like the sea,
Pure as the naked heaven, majestic, free,

is true alike of his heaven-sent Muse and of his essential character. J. D.

Continued from page 324.

HISTORY:

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BRITAIN'S STORY.—IV

[*The introductory chapter to* LORD MACAULAY'S "*History of England*" *has been adopted in this work to explain the development of the British race prior to* 1660. *But as Lord Macaulay's work was intended merely as a sketch, explanatory passages* (*printed in closer type*) *have been interpolated in order to meet the requirements of the student.*]

EARLY in the fourteenth century the amalgamation of the Norman and English was all but complete; and it was soon made manifest that a people inferior to none existing in the world had been formed by the mixture of three branches of the great Teutonic family with each other, and with the aboriginal Britons. There was, indeed, scarcely anything in common between the England to which John had been chased by Philip Augustus, and the England from which the armies of Edward III. went forth to conquer France.

A period of more than a hundred years followed, during which the chief object of the English was to establish, by force of arms, a great empire on the Continent. The claim of Edward to the inheritance occupied by the House of Valois was a claim in which it might seem that his subjects were little interested. But the passion for conquest spread fast from the prince to the people.

The Hundred Years War

The war differed widely from the wars which the Plantagenets of the twelfth century had waged against the descendants of Hugh Capet. For the success of Henry II., or of Richard I., would have made England a province of France. The effect of the successes of Edward III. and Henry V. was to make France, for a time, a province of England.

The disdain with which, in the twelfth century, the conquerors from the Continent had regarded the islanders, was now retorted by the islanders on the people of the Continent. In no long time our ancestors altogether lost sight of the original ground of quarrel. They began to consider the crown of France as a mere appendage to the crown of England; and when, in violation of the ordinary law of succession, they transferred the crown of England to the House of Lancaster, they seemed to have thought that the right of Richard II. to the crown of France passed, as of course, to that house.

The zeal and vigour which they displayed present a remarkable contrast to the torpor of the French, who were far more deeply interested in the event of the struggle. The most splendid victories recorded in the history of the middle ages were gained at this time, against great odds, by the English armies. Victories indeed they were of which a nation may justly be proud; for they are to be attributed to the moral superiority of the victors, a superiority which was most striking in the lowest ranks.

Fourteenth Century England

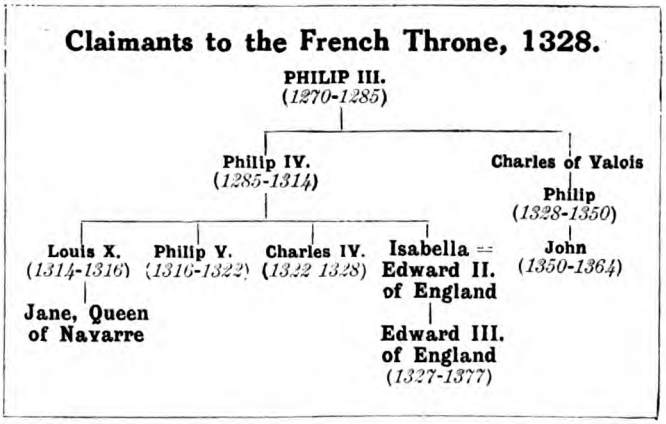
Nor were the arts of peace neglected by our fathers during that stirring period. While France was wasted by war, till she at length found in her own desolation a miserable defence against invaders, the English gathered in their harvests, adorned their cities, pleaded, traded, and studied in security.

Many of our noblest architectural monuments belong to that age. Then rose the fair chapels of New College and of Saint George, the nave of Winchester and the choir of York, the spire of Salisbury and the majestic towers of Lincoln. A copious and forcible language, formed by an infusion of French into German, was now the common property of the aristocracy and of the people. Nor was it long before genius began to apply that admirable machine to worthy purposes. The same age which produced the Black Prince and Derby, Chandos and Hawkwood, produced also Geoffrey Chaucer and John Wycliffe.

Yet while we contemplate with pleasure

the high and commanding qualities which our forefathers displayed, we cannot but admit that the end which they pursued was an end condemned both by humanity and by enlightened policy, and that the reverses which compelled them, after a long and bloody struggle, to relinquish the hope of establishing a great continental empire, were really blessings in the guise of disasters. The spirit of the French was at last aroused: they began to oppose a vigorous national resistance to the foreign conquerors; and after many desperate struggles, and with many bitter regrets, our ancestors gave up the contest.

Since that age no British government has ever seriously and steadily pursued the design of making great conquests on the Continent. The people, indeed, continued to cherish with pride the recollection of Cressy, of Poitiers, and of Agincourt. Even after the lapse of many years it was easy to fire their blood and to draw forth their subsidies by promising them an expedition for the conquest of France. But happily the energies of our country have been directed to better objects; and she now occupies in the history of mankind a place far more glorious than if she had, as at one time seemed not improbable, acquired by the sword an ascendency similar to that which formerly belonged to the Roman republic.



The history of France, as we learned in Vol. I., page 272, really began in 987, when Hugh Capet assumed the crown of the Carlovingians.

Now, Hugh Capet owed his success largely to the fact that the Carlovingian kings were abandoned in their hour of weakness by the Norman dukes. There was no love lost, however, between these dukes and the new dynasty. On the contrary, a natural enmity existed between the ambitious suzerain and the too powerful vassal; and, when the Dukes of Normandy became Kings of England, the latter country found herself involved.

Yet, at this time, there was no racial hatred between the English and the French; the hostility was due almost entirely to the strained relations between the early Capetians and the Norman dukes.

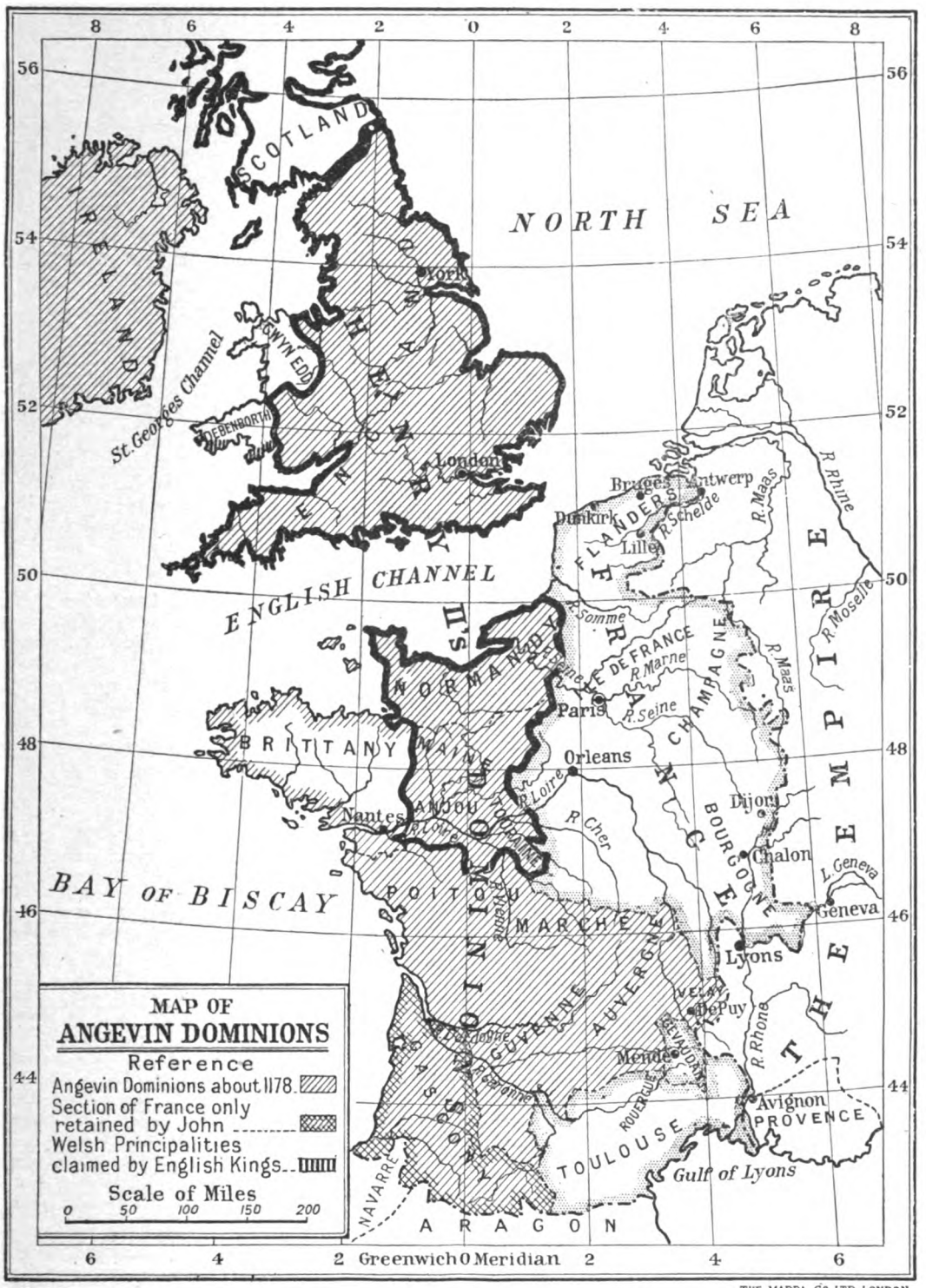
William I., who, of course, was Duke of Normandy as well as King of England, carried on a stern struggle with the French King, Philip I., for the possession of the Vexin, the province which lay on the borderland of France and Normandy; and died during the campaign. When *William II.* came to the throne in 1087, England and Normandy were temporarily separated, the Conqueror having bequeathed the latter dominion to his elder son, Robert. The French King and William Rufus, however, continued to fight about the Vexin; and the struggle was carried on with increased intensity during the reign of *Henry I.* (1100–1136), when England and Normandy were reunited.

During the troublous reign of *Stephen* (1134–1154) the foreign relations of England were entirely suspended, but upon the accession of *Henry II.* her position in regard to France again became difficult, owing to the fact that Henry, in addition to being King of England, ruled over a larger part of France than did the French King himself, and was therefore even less likely than his predecessors to prove a willing vassal.

From his father, Geoffrey of Anjou, Henry inherited Anjou and Touraine; from his mother, Matilda, daughter of Henry I., he inherited Normandy and Maine, together with a feudal superiority over Brittany; whilst by his marriage with Eleanor, Duchess of Aquitaine—a lady whose sole attraction was the extent of her possessions—*he became ruler of a large territory extending from the Loire to the Pyrenees, and was also given a shadowy claim to Toulouse.*

This latter involved Henry in the so-called War of Toulouse. But the King of England abstained from availing fully himself of this opportunity to make new conquests, being deterred by feudal scruples from delivering an open attack on his over-lord, King Louis VII. of France. Louis, for his part, experienced no such scruples, and never lost an opportunity of attacking Henry. He attacked him in 1167, during the English King's quarrel with Becket; whilst in 1173, and again later in the reign, he encouraged and helped Henry's sons to revolt against their father.

Of so permanent a nature was the jealousy between the Kings of France and England that, although *Richard I.* of England and Philip Augustus of France agreed to suspend hostilities in order that they might join the *Third Crusade*, a quarrel broke out between them almost immediately after their arrival in Palestine, and Philip returned prematurely to Europe in order to arrange attacks on Normandy.



In connection with the above map, which shows the varying fortunes of those provinces of France which owed allegiance to the English Crown in the Middle Ages, it is interesting to note that not until 1802 did the Kings of England abandon the title of King of France, which Edward III. adopted in 1340. Calais, the last foothold which the English monarchy retained in France, was lost in 1558 during the reign of Mary.

Henry II.'s youngest son, *John*, had at one time been on very friendly terms with Philip. On his succession, however, to the throne of England (1199) his friendship immediately turned to hatred.

Now, if John was an incompetent ruler, he was a thoroughly incompetent soldier, and before the end of his reign continued to lose to his rival and feudal over-lord practically the whole of the extensive continental dominions which he had inherited. The English people, however, were far from regarding these defeats as a national disaster. Indeed, so slight was the opposition in England to the French King's triumphs that, towards the end of John's reign, the barons, enraged by the King's repudiation of *Magna Carta*, invited Philip's son Louis to avenge their wrongs, and occupy their throne.

A union of the two crowns at this time would undoubtedly have been a national disaster. And England was saved from it only by the timely death of John and by the staunch manner in which the Earl of Pembroke championed the cause of Henry III., the late King's eldest son, at that time a lad nine years of age.

Thus King John all unwittingly proved himself one of his country's greatest benefactors, for to his reckless misgovernment and folly were directly due the two most fortunate events in English history —the passing of the Great Charter and *the final separation of England and Normandy*. The results of the latter may not at first have been apparent. None the less, it had an even more salutary effect on the future of the country than did the provisions of the Great Charter. England and France henceforth each pursued a separate course; and England, though still largely French in speech and manners, became conscious of national identity; whilst in France, materially strengthened by the annexations of Philip Augustus, the national sentiment began also to develop.

From a drawing by Caton Woodville.

"BRING OUT YOUR DEAD!"

A bereaved father answering the grim cry frequently heard in the streets of London in 1348, when the Black Death raged in the land, and science had not found means of arming man against its ravages. During the plague two hundred persons were buried daily at Charterhouse Yard in London alone.

Salic Law

The retention of Guienne by *Henry III.* (1216–1272) and his successors served, it is true, to preserve for a while the feudal tie. None the less, national hostility came gradually to take the place of the old feudal hostility; and that momentous struggle, known commonly as *The Hundred Years War*, which *Edward III.* (1327–1377) began in 1338, as a result of his preposterous claim to the throne of France, was essentially a national war.

In 1328 the old line of French Kings died out, and Edward III. of England, being the son of Charles IV.'s sister, Isabella (*see* the genealogical table in the middle of page 386) chose to contest the accession of Philip of Valois.

Edward's claim was wholly lacking in legal justification, since, according to the so-called *Salic Law*, which was in force in France at that time, the French Crown could not descend in the female line, but it served as a convenient excuse for England to begin a war which, in the opinion of the King, the increasing power of the French monarchy rendered essential in her national interests.

The English nation was by no means unwilling to engage in such a struggle.

From 1337 to 1340 an indecisive campaign was conducted on the northern borders of France. The fickleness of England's allies then necessitated the conclusion of a truce. This continued until 1345, when the war again became general. In the

following year, Edward landed with a great army in Normandy, and, after a destructive inroad, won the famous victory of *Crecy* (1346), which he followed up by besieging and taking *Calais* in 1347.

Soon after the fall of Calais, a terrible plague, known as the *Black Death*, broke out in England. This scourge made the resumption of the war impossible until 1355, when the *Black Prince*, Edward III.'s heir, landed in France and began the memorable campaign which ended with the battle of *Poitiers* (1356) and the capture of King John of France.

Battle of Agincourt

A period of anarchy ensued in France, and Edward availed himself of the opportunity to conclude a very favourable peace. This treaty—the *Peace of Bretigny* (1360)—was never really carried out, and the war continued in a desultory manner until, thanks to the military skill of the Constable Duquesclin, the French began to recover some of their lost prestige. By 1374 they had regained the whole of Guienne, with the exception of a few towns on the coast; whilst in the north the English were left in possession only of Calais.

During the minority of *Richard II.* of England, that is to say, from 1377–1397, hostilities were virtually suspended; and Richard when he came of age made no attempt to renew the quarrel.

In 1399 Richard II. was deposed, and during the ensuing political troubles there was no serious renewal of the war until the vigorous *King Henry V.* ascended the English throne (1413).

In 1415 Henry gained a decisive victory at *Agincourt* over the Burgundians and Armagnacs, who for once combined in defence of their country. In 1417, profiting by the renewal of civil strife in France, Henry overran Normandy; and two years later, having in the meanwhile won the whole of the Burgundian party over to his side, he entered Paris, where he concluded the *Treaty of Troyes*.

By the terms of this treaty it was agreed that Henry should succeed to the throne of France on the death of King Charles VI., at that time an aged imbecile. Henry, however, did not live to enjoy the fruits of his success. In 1422 he died; and, since his heir, *Henry VI.*, was only an infant ten months old, Charles VI.'s son decided to ignore the Treaty of Troyes, and, having proclaimed himself King Charles VII., renewed the war with England.

Joan of Arc

At this time there passed over France a strong feeling of patriotism, which found its highest expression in the heroic career of Joan of Arc. In 1429 Joan of Arc inflicted a crushing defeat on the English at Patay; then marched on Rheims to crown Charles King. Her attacks on Paris proved unsuccessful. None the less, so thoroughly did the Maid of Orleans rekindle the spirit of nationality throughout northern France that neither the coronation of Henry VI. at Paris nor Joan's capture and execution in 1431 could restrain the ardour or successes of the French. In 1435 Burgundy abandoned the English. In 1437 Paris was lost. By 1449 all of Normandy had fallen into the hands of the French. Guienne fell next; and in 1453 Calais was the only remaining English possession in France.

From the picture by R. Wheelwright. By permission of the Autotype Fine Art Co

JOAN OF ARC TAKEN PRISONER.

Believing that she had a divine commission to expel the English who were ing Orleans, the French king, Charles VII., in 1429 entrusted Joan of Arc with the com an army. Her extraordinary military career ended at the siege of Compiègne (1430); h laid of Orleans was taken prisoner. In the following year she was condemned as a wit d at Rouen.

Continued from page 344.

SCIENCES:

Contributors:—ANTHROPOLOGY AND ETHNOLOGY (Sir H. H. Johnston, G.C.M.G., K.C.B.). ASTRONOMY (Arthur R. Hinks, M.A., F.R.S.). BOTANY (E. W. Edmunds, M.A., B.Sc.[Lond.]). CHEMISTRY (E. H. Tripp, Ph.D.). ELECTRICITY AND MAGNETISM (L. M. Parsons, M.Sc., D.I.C., F.G.S.). GEOLOGY AND MINERALOGY (Arthur Holmes, D.Sc.[Lond.], A.R.C.S., D.I.C., F.G.S.). PHYSIOLOGY (Sir Malcolm Morris, K.C.V.O., and D. W. Carmalt-Jones, M.A., M.D.[Oxon.]). SOUND, LIGHT, AND HEAT (E. W. Edmunds, M.A., B.Sc.[Lond.]). ZOOLOGY (E. A. Bryant and Ashley G. Brown, F.Z.S.).

CHEMISTRY.—XV

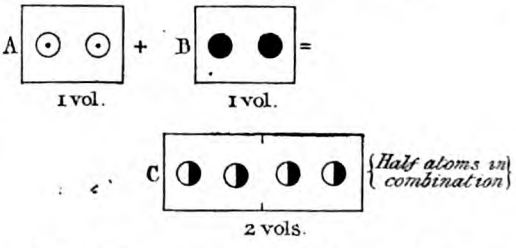
Molecular and Atomic Weights.—The Law of Constant Proportions asserts that elements unite in fixed, determinate proportions by weight, whether they be solid, liquid, or gaseous. There is another law of extreme simplicity which summarises the relationship between the volumes of interacting gases, irrespective of their elementary or compound nature.

In Experiment XXXIV. we learnt that two parts of hydrogen by volume unite with one part by volume of oxygen to form water, the volume of the latter being of no consideration because it is not a gas. It is, however, possible to effect the union of measured volumes of hydrogen and oxygen in a eudiometer tube which is maintained at above 100° C. by surrounding it with the vapour of a liquid, like amyl alcohol, which is well above that temperature; and it is then observed that 2 volumes of hydrogen combine with 1 volume of oxygen to produce 2 volumes of steam.

Further, in Experiment XLII., it was found that 2 volumes of hydrogen chloride are produced by the union of 1 volume of hydrogen and 1 volume of chlorine. Experiments also demonstrate that when carbon and sulphur are burnt in oxygen, the volumes of the resulting gases are exactly equal to the volume of the oxygen consumed in the combustion. Now in all these instances the numerical relations between the volumes of the gases concerned are exceedingly simple: they can be expressed by small whole numbers.

A large number of accurate experiments has shown conclusively that "*When gases interact, their volumes bear a simple proportion to one another, and also to the product of the reaction if it be a gas.*" This general statement of fact is known as *Gay-Lussac's Law of Volumes.*

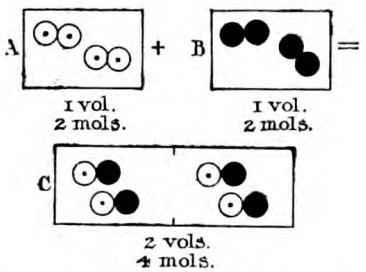
If we assume that chemically interacting substances are composed of minute, discrete particles of constant weight, and if we add to this supposition the knowledge that those substances which are gases also interact in simple proportions by volume, we are led to the thought that there may be some simple relation between the volume of a gas and the number of its interacting particles, i.e. of its atoms or molecules. The first attempt to establish such a relation consisted in assuming that equal volumes of all gases, at the same temperature and pressure, contain an equal number of atoms; but this statement was shown to be at variance with the more fundamental assumption of the indivisibility of atoms during chemical changes.



If A and B represent equal volumes of hydrogen and chlorine, and C the volume of hydrogen chloride produced by their combination, then, according to experiment, C is double A or B; A, B and C all being at the same temperature and pressure. Let there be 2 atoms of hydrogen (each represented by ○) in A, then on the assumption that equal volumes of gases contain the same number of smallest particles, there will be 2 atoms of chlorine (each represented by ●) in B, and 4 smallest particles of hydrogen chloride in C. Now each of the last-named must contain both hydrogen and chlorine, and hence to obtain 4 of them from 2 atoms of hydrogen and 2 atoms of chlorine, it is imperative that each hydrogen atom and each chlorine atom should be split into two parts, which by the atomic hypothesis is impossible.

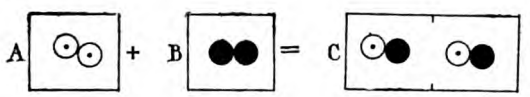
The solution of the difficulty was indicated in 1811 by Avogadro, who affirmed that "*Equal volumes of all gases, at the same temperature and pressure, contain an equal number of molecules.*" On this assumption it is possible to give a pictorial representation of the union of hydrogen and

chlorine (and also of all other chemically interacting gases), which does not clash with any other assumption involved. Thus:—



The statement of Avogadro not only affords satisfactory mental pictures of chemical changes, but also establishes a basis from which many important conclusions can be drawn. Three such deductions must now receive attention.

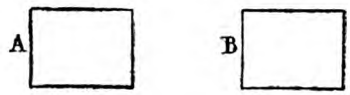
(1) *The hydrogen molecule consists of at least two atoms*:—



As before, let A, B and C represent 1, 1 and 2 volumes of hydrogen, chlorine and hydrogen chloride respectively, all measured at the same temperature and pressure. If there are n molecules of hydrogen in A, then by Avogadro's statement there are n molecules of chlorine in B, and $2n$ molecules of hydrogen chloride in C, n being any whole number. Put $n = 1$, then it follows that 1 molecule of hydrogen unites with 1 molecule of chlorine to form 2 molecules of hydrogen chloride. Since atoms are indivisible, each molecule of hydrogen chloride contains at least one atom of hydrogen, and therefore 2 molecules of hydrogen chloride contain at least 2 atoms. But these 2 atoms of hydrogen were derived from the 1 molecule of hydrogen: therefore the latter contained at least 2 atoms. As there is evidence to show that there are not more than 2 hydrogen atoms in the molecule, this element is always regarded as diatomic, the term *atomicity* being used to signify the number of atoms contained in the molecule of an element.

Since hydrogen is the lightest of all elements, it is found convenient to take the weight of its atom as unity. As the absolute weights of atoms and molecules are of no importance to the chemist—and they can only be guessed at—it is perfectly arbitrary which atom be taken as of unit weight, and what particular weight be assigned to it; but for didactic purposes the acceptance of the atomic weight of hydrogen as unity has much to recommend it. This being so, it follows that, since the hydrogen atom weighs 1, and there are 2 atoms in the molecule, the molecular weight is 2.

(2) *The molecular weight of a gas is equal to twice its density referred to hydrogen.* A and B represent equal volumes of hydrogen and oxygen at the same temperature and pressure. Experiment shows that any volume of oxygen is (approximately) sixteen times heavier than the same volume of hydrogen, or, in other words, the density of oxygen is 16 when that of hydrogen is 1. If there are n molecules of hydrogen in A, there are also n molecules of oxygen in B. Since, then, n molecules of



oxygen weigh 16 times as much as n molecules of hydrogen, it follows that 1 molecule of oxygen is 16 times heavier than 1 molecule of hydrogen. But the hydrogen molecule weighs 2: therefore the oxygen molecule weighs $16 \times 2 = 32$, which is twice the density (16).

If the molecular weight of a substance be expressed in grams the number is called the gram-molecule: thus the gram-molecule of oxygen is 32. One gram of hydrogen is found to occupy 11·124 litres (often termed 1 volume for brevity) at N.T.P.; hence 2 grams, or the gram-molecule, occupy $2 \times 11{\cdot}124 = 22{\cdot}25$ litres (or 2 volumes). Since by Avogadro's statement the relative weights of equal volumes of gases are also the relative weights of their molecules, it follows that *the gram-molecules of all gases occupy the same volume, viz. 22·25 litres at N.T.P.*, and this conclusion is verifiable by experiment. Practically, therefore, the determination of the molecular weight of a gas resolves itself into finding the weight of 22·25 litres measured at 0° C. and 760 mm.

270 c.c. of a gas at 15° C. and 740 mm. weigh 1·32 grams. Calculate the molecular weight

270 c.c. at 15° C. and 740 mm. will occupy at N.T.P.,

$$270 \times \frac{273}{288} \times \frac{740}{760} \quad \text{(See pp. 326, 327.)}$$
$$= 249{\cdot}2 \text{ c.c.}$$

Then, since 249·2 c.c. weigh 1·32 grams,

$$\therefore \text{ 22·25 litres or 22,250 c.c. weigh } \frac{1{\cdot}32}{249{\cdot}2} \times 22{,}250$$
$$= 119{\cdot}2, \text{ the value of the molecular weight.}$$

(3) *The determination of the atomic weight of an element. Chemical Method.*—In accordance with our definition of an atom as the smallest particle of any element which is ever found in combination with other elements, the atomic weight of an element must be regarded as the smallest weight of it which is anywhere found in combination, i.e. which is ever found in a molecule of any of its compounds. If it be required to find the atomic weight of an element, such as oxygen, it is first necessary to obtain as many of its compounds as possible which are gases or which can be readily vaporised. Such compounds of oxygen are water, sulphur dioxide, sulphur trioxide, nitric oxide, carbon dioxide, and carbon monoxide.

The next step is to find the density of these substances in the gaseous form, and to multiply the numbers obtained by 2, in order to get their molecular weights. These weights are 18, 64, 80, 30, 44, and 28 respectively. The third step is to analyse these compounds and to find the proportions of oxygen in them, such proportions being expressed, not in percentages, but as parts by

weight of oxygen in a molecular weight of the compound. Such analyses give that the molecular weights of the oxygen compounds mentioned contain respectively, 16, 32, 48, 16, 32, and 16 parts of oxygen. The smallest weight, 16, is accordingly taken as the atomic weight.

It should be noted that this method is only applicable to such elements which form gaseous compounds, and to be reliable it is essential that a considerable number of compounds should be available, otherwise the value found for the atomic weight may be too large ; it cannot be too small, for the atomic weight is the *smallest* weight found in a molecule of any of its compounds.

The determination of atomic weights by the method of Specific Heat.—The student of Heat will have learnt that all heat measurements are expressed in terms of the *calorie*, which is the amount of heat required to raise the temperature of 1 gram of water through 1° C. (or more accurately, from 0° to 1° C.); also that equal weights of different materials require different amounts of heat to raise them through 1°. These quantities of heat are called the "capacities for heat" of the substances, although the term "specific heat" is often used instead. (These two terms may, for practical purposes only, be considered as equivalent.)

The French physicists, Dulong and Petit, discovered that the product of the specific heat and the atomic weight of a metal was approximately equal to 6·4. This number is known as the "atomic heat," and it represents the number of calories required to raise the atomic weight of a metal expressed in grams through 1° C., e.g. the specific heat of lead is 0·031, and its atomic weight 206·4.

Now 0·031 × 206·4 = 6·4, i.e. 6·4 calories are needed to raise 206·4 grams of lead through 1° C. Since, then, Spec. Ht. × At. Wt. = 6·4, the atomic weight of a metal can be found by dividing 6·4 by its specific heat. This method is found to be applicable to nearly all the metals and to some of the solid non-metallic elements; but as the number 6·4 is not quite constant, the value found for the atomic weight is only approximate. The same remark applies to the value determined by the chemical method, since vapour density determinations are seldom very exact. In order to arrive at accurate atomic weights, use has to be made of the equivalents of the elements, for these can be found with a high degree of accuracy. The atomic weight is either equal to or is a simple multiple of the equivalent. Thus, if the atomic weight of an element be found equal to 27·1 by either of the methods described above, and its equivalent be 8·96, it is obvious that the required multiple is 3, and since 3 × 8·96 = 26·88, this value is taken as the correct atomic weight. In a similar manner the approximate value found for a molecular weight may be made accurate, e.g. the vapour density of chlorine was found to be 35·75, therefore its approximate molecular weight = 2 × 35·75 = 71·50. But the equivalent of this element is 35·22; therefore the true molecular weight = 2 × 35·22 = 70·44.

E. H. T.

LIGHT.—III

6. Rays by which the Eye sees an Image.—Only a limited number of rays passing from the object need strike the eye in order that the image may be seen in the mirror. Let E F (Fig. 14) represent the position of the eye, P that of the object, and Q its image in the mirror. Join Q E, Q F, cutting the mirror at M and N. Join M P, N P. Then the light included within M N P is the pencil which, after reflexion, enters the eye and *seems* to proceed from Q. All the light outside this pencil is useless in viewing the image of P.

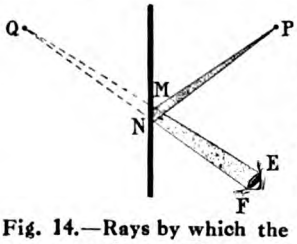


Fig. 14.—Rays by which the eye sees an image. The pencil included within M N P is the pencil which, after reflexion, enters the eye and seems to proceed from Q.

It is clear also that it is not necessary to see P in order to see Q; a screen which separates P from the eye, and does not stand in the way of the pencil P M N, M N E F, does not cut off the view of the image Q. Hence mirrors can be easily arranged to view invisible objects, and light may be reflected from clouds when the sun, its source, is below the horizon.

If the object is of larger size, as O P (Fig. 15), the same principle applies; we deal with the extreme points, which give us the outside limits of the light necessary.

7. Multiple Reflexion.—If two mirrors are placed parallel and with their reflecting surfaces face to face, an object placed between them will, of course, give an image in each mirror. But it is clear also that light reflected from one mirror may fall on the other, so that a second image will be seen in the latter. This reflexion to and fro may go on several times, and several images will be seen in each mirror.

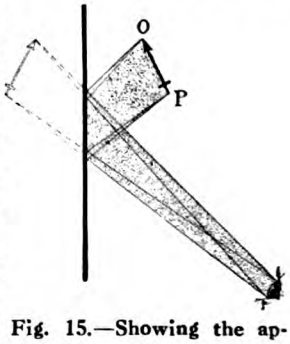


Fig. 15.—Showing the application to larger objects of the principle laid down in Fig. 14.

Let P_1 and Q_1 be the images formed by reflexion in the two mirrors. The position of the second image P_2 is such as it would be if Q_1 were the object, and Q_2 bears the same relation to P_1. So P_3 is formed as if Q_2 were its source, and so on. This should be carefully verified both by experiment and by geometrical construction, as indicated in Fig. 16.

In that figure the course of the light has been drawn by which the eye sees the fifth image in the right-hand mirror. A single ray only has been drawn, but the same construction will, of course,

hold good for a pencil of rays. The method of procedure is as follows: Join the eye to P_5 cutting the mirror at E. Now join E Q_4, because Q_4 is the point of which P_5 seems to be the image. Join D P_3, C Q_2, B P_1 and A O. Then O A B C D E F represents the course of one of the rays by which the eye sees P_5.

Now place the mirrors at right angles. Three images only will be seen. Of these, P_1 and Q_1 are

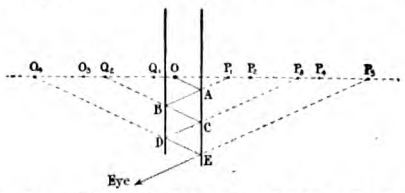


Fig. 16.—The principle of multiple reflexion.

those produced by a single reflexion from each of the mirrors. P_2 and Q_2, produced by a second reflexion from the second mirror in each case, coincide in position, and further reflexion is clearly impossible. Note carefully that O P_1 P_2 Q_1 forms a rectangle, and that each of those four points lies on a circle with A as centre. Fig. 17 shows the pencil by which P_2 is viewed by the eye.

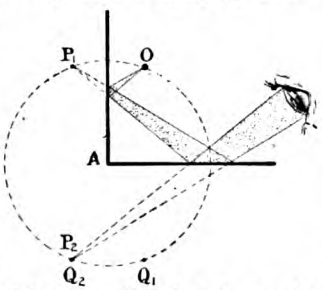


Fig. 17.—Showing the pencil by which the second image, P_2, is viewed by the eye.

Keeping the object at O, bring one mirror closer to the other by diminishing the angle between them. The number of images increases as the angle diminishes: at 60° there are 5, at 45° there are 7, and at 30° there are 11. In each case they all lie on a circle of which A O is the radius. The student should draw carefully the position of the images he expects to see, and compare them with observed results. He will find that the number of images is given by the formula $\frac{360}{A} - 1$, where A is the angle between the mirrors. Thus when A = 72°, the number of images is $\frac{360}{72} - 1 = 4$.

Two mirrors placed at an angle of 60° are the fundamental thing in the well-known child's toy, the kaleidoscope. The mirrors are placed at the bottom of a cardboard tube, into which light is let by translucent glass. A few pieces of coloured glass between the mirrors, by their multiple reflexions, cause the variegated pattern (Fig. 18), which is so fascinating and wonderful to a child's mind.

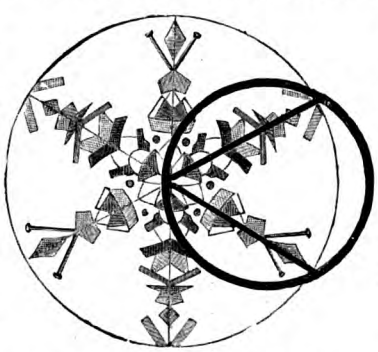


Fig. 18.—The multiple reflexions, resulting from the placing of a few pieces of coloured glass between two mirrors, gives rise to a remarkable variegated pattern.

8. Reflexion from Curved Surfaces.—In order that a mirror may behave in this way, it must be (1) highly polished, (2) plane. If the surface is rough, the light may still be reflected, but it will be reflected irregularly, so that the reflected rays do not intersect at *one* point and produce a definite image. Put in another way—the waves of light which fall on a rough surface are scattered like the waves of the sea on a rough coast (Fig. 19).

But a mirror suitably polished may be curved, and the normal laws of reflexion apply to them. They produce, however, special results which demand special study. We shall consider only the case of spherical mirrors here: i.e. of mirrors whose reflecting surface is a portion of a sphere. These mirrors are spoken of as *concave* or *convex*, according as the reflecting surface is on the inside or outside of the sphere. A small portion of the sphere is quite sufficient to show all the phenomena to be described.*

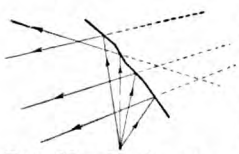


Fig. 19.—If the surface of a mirror be rough, light will be irregularly reflected.

If a candle flame or small lamp be placed at some distance from a concave mirror, a real image, small and inverted, can be collected on a screen placed at a suitable point. This position can be obtained by trial. A sheet of paper should be moved about between the light and the mirror until the exact image, and not a mere luminous blur, is obtained on it (Fig. 20).

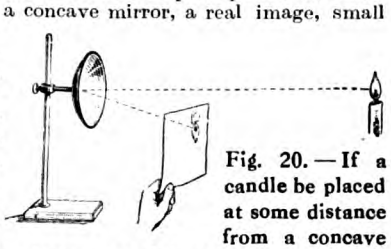


Fig. 20.—If a candle be placed at some distance from a concave mirror, a real image, small and inverted, can be collected on a suitable screen.

This can readily be done if care is taken not to interpose the screen so as to cut off the light from the mirror. The small image will be seen to be a *real* luminous one, and it will be found that only at one place it is an exact picture of the lamp or candle. If now the candle is brought gradually nearer to the mirror, the image is found to be formed farther and farther away, remaining inverted and smaller than the object, though steadily growing larger. As the candle still moves nearer, there comes a point where the image is formed at the same distance from the mirror as the candle.

* Concave and convex mirrors can be bought from dealers in scientific apparatus at a small cost, provided with screws to fix them on a retort stand or other convenient support. Personal observation of the results described is most desirable to the student.

This point, we shall learn, is the geometric centre of curvature of the mirror; and here the object and its image are equal in size.

Moving the candle still nearer, the image is now formed farther out, and becomes larger than the object, and still inverted. The limit comes when the candle reaches a point about midway between the centre and the mirror. Beyond this point no real image can be collected on the screen; but, looking into the mirror, an enlarged virtual image of the candle will be noticed.

This sequence of events should be very carefully observed and recorded. They can be confirmed by looking in the mirror at the image of oneself. Only when the mirror is close to the face can the enlarged virtual image be seen. No more than a blur is seen when the mirror is held at arm's length.

Thus it will be seen that a concave mirror yields both real and virtual images under different conditions. Experiment with a convex mirror on the same lines will reveal the fact that real images are never formed with it; virtual images, small and not inverted, are formed wherever the object is placed.

9. Relation between Position of Object and Position of Image.—We must now examine these facts a little more exactly through the law of reflexion and the geometrical results that follow from it.

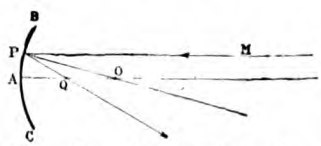


Fig. 21. — Illustrating the principal focus of a mirror.

Let B A C (Fig. 21) represent a concave mirror, of which A is the centre. Let O be the centre of curvature—the centre, that is, of the sphere of which B A C is part. Then O A is called the *axis of the mirror*, and the length O A the *radius of curvature* of the mirror. O A (and any other straight line drawn from O to B A C) will be perpendicular to the surface of the mirror.

Now consider a ray of light M P parallel to O A and striking the mirror at P. The course of this ray after reflexion will be found by making the angle of reflexion O P Q equal to the angle of incidence M P O. Remember that O P is normal to the mirror at P. Let P Q cut the axis O A at Q. Now since M P is parallel to O A, the angle M P O = angle Q O P; $\therefore \angle$ P O Q = $\angle$ O P Q; $\therefore$ Q P = Q O. But if P is close to A, Q P is very nearly equal to Q A. Consequently Q may be taken as the middle point of A O. But M P is *any* ray parallel and very near to O A: hence all such rays intersect O A at its middle point Q.

Fig. 22.—A caustic curve.

This point is known as the *principal focus* of the mirror, and the distance A Q as its *focal length*. The position and definition of this point is of special importance; we therefore state again: *the principal focus of a mirror is the point at which a small pencil of rays parallel to and near to the axis intersect.*

The student should draw on the large scale the course taken by a number of rays parallel to the axis of a concave mirror. He will then see that those rays which are far removed from the axis do not cross one another at Q. The light tends to distribute itself in the form of a curve called a *caustic*, with enhanced intensity at and near Q. The form of the caustic in the case of a hemisphere is an epicycloid, such as is shown in Fig. 22. It may be beautifully observed on the surface of a cup of tea or a glass of milk (not quite full) when a bright light falls on the inside surface of the cup or glass.

The student will have observed in making the experiments of §8 that the image of the candle was usually surrounded by irregular streaks and lines of light. This is mainly due to the fact that he used the rays reflected from the whole of the mirror. If the mirror is covered with a sheet of brown paper so as to leave only a small circular hole near A for the purposes of reflexion, the irregularities will be found to disappear. This should always be done when experimental work is being carried out with a concave mirror.

Experiment.—Find the focal length of a concave mirror by obtaining the position of the image of the sun or other distant source of light. Hence find the radius of curvature of the mirror. Take care to arrange the mirror and the source of light so that the latter is on the axis, A O produced.

We now proceed to find the position of the image of any point M placed on the axis of the mirror. Take any ray M P striking the mirror at P, and as before make $\angle$ M P O = $\angle$ O P Q. Then P Q is the course of the reflected ray. And as the ray M A, being normal to the mirror, is reflected back along A M, the point Q, where P Q and A M intersect, will be the position of the image. This latter condition obtains, as before, only in the case of those rays which are close to O A.

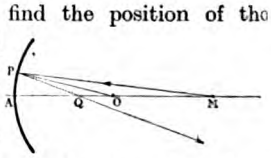


Fig. 23.—To find the focal length of a concave mirror.

In the triangle P Q M, since the angle M P Q is bisected, we have

$$\frac{PQ}{PM} = \frac{QO}{OM},$$

which becomes, if P be very near to A,

$$\frac{AQ}{AM} = \frac{QO}{OM}.$$

Let u = the distance of the object, and v the distance of the image from the mirror; r = the radius of curvature, and f, the focal length of the mirror. Then A Q = v, A M = u, Q O = $r - v$, $O M = u - r$; and

$$\frac{v}{u} = \frac{r-v}{u-r};$$

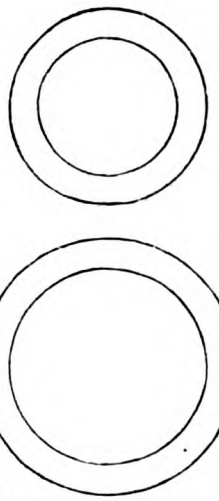
or, $uv - vr = ur - uv$;

or, $ur + vr = 2uv$;

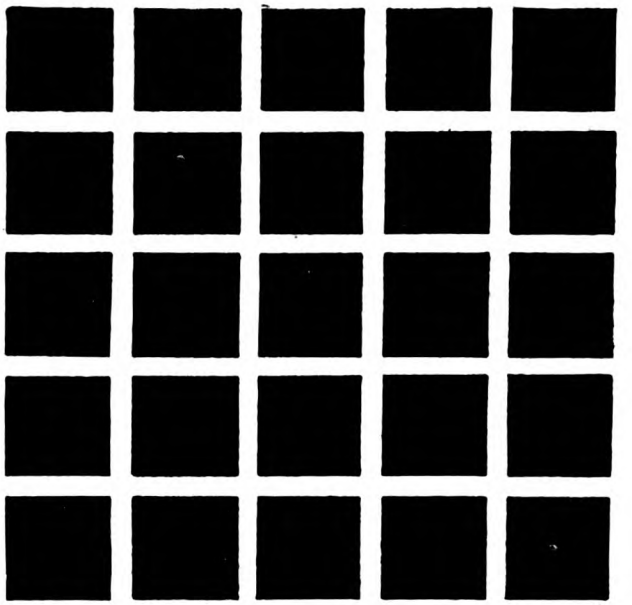
or, dividing by uvr, $\frac{1}{v} + \frac{1}{u} = \frac{2}{r}$.

This formula, $\frac{1}{u} + \frac{1}{v} = \frac{2}{r} = \frac{1}{f}$, must be committed to memory.

It is important to notice in this formula that u and v are interchangeable: if u be made equal to v,

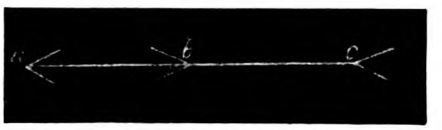


A circle appears larger if surrounded by a circle larger than itself, and smaller if a smaller circle is shown concentrically within it.

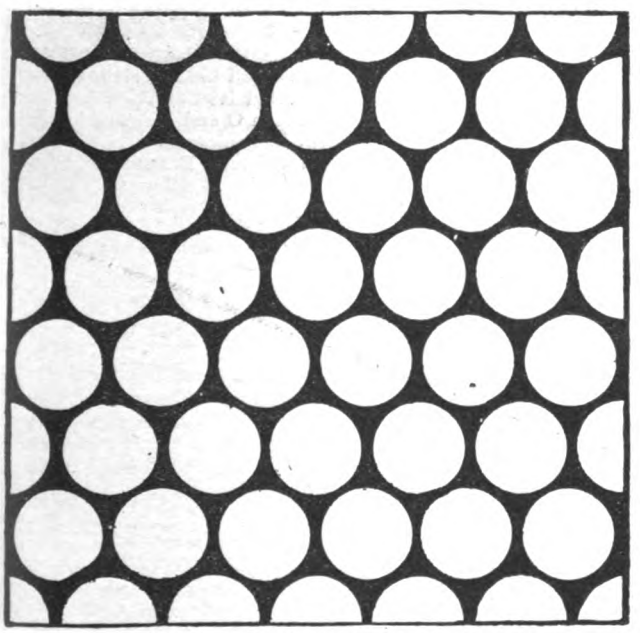


When white bands separate black squares, the white bands appear by contrast to be darker at the points of intersection than when they are bordered on each side by black squares.

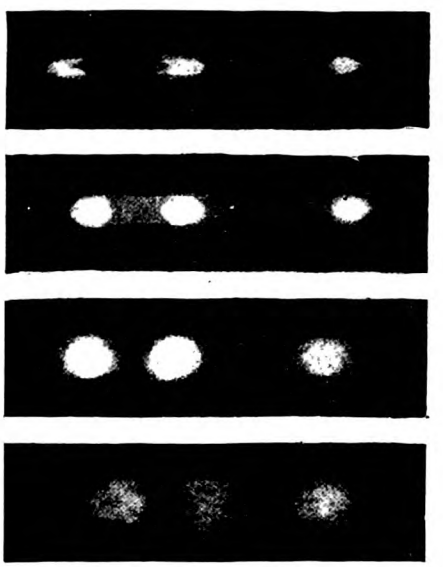
An illusion of motion. Hold the figure close to the face and look beyond it. The bird will appear to move into the cage.



An illusion in space perspective. The line a—b is of the same length as the line b—c. Below is an explanation of the illusion.



If the above figure be held a certain distance from the eyes, the white circles will appear to be hexagonal. This is because irradiation is most marked.



A commonly accepted explanation of the space perspective phenomenon shown above.

SOME OPTICAL ILLUSIONS

which show very clearly that we should not accept unquestioningly even the evidence of the eye, "the queen of the senses." In the case of the bird-cage illusion, a card held vertically between the eyes will add to the effect. Cf. the illusions on p. 461.

The illusions on this page are reproduced by kind permission of Professor William Stirling, Professor of Psychology in the University of Manchester.

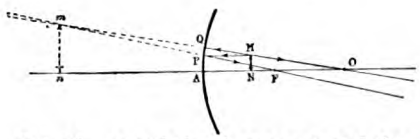


Fig. 24.—M N being between F and the mirror, the image is erect, virtual and enlarged.

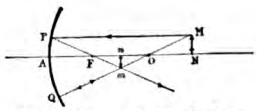


Fig. 25.—M N being outside O, the image is small and inverted.

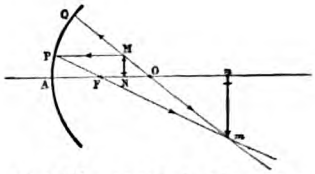


Fig. 26.—M N being between O and F, the image is real, inverted and enlarged.

then $v = u$. This means in practical experiment that, if the object be placed where its image was formed, the new image will be found exactly where the object was originally. The positions of object and image are what is called in geometry *conjugate foci*.

From the formula we may note that, when $u = r$, $v = r$: i.e. the image of an object at the centre of the mirror is formed also at the centre.

Again, when u is infinite, i.e. when the light falls parallel on to the mirror, $\frac{1}{u} = \frac{1}{\infty} = 0$, or $v = f$, according to definition. Conversely, when $u = f$, $\frac{1}{v} = 0$, or $v = \infty$, and the image is formed at infinity.

Suppose the object placed nearer to the mirror than the principal focus: u is less than f; $\frac{1}{u}$ is greater than $\frac{1}{f}$, so that $\frac{1}{v}$ is negative. This means that v is then measured in the opposite direction: in other words, the image is behind the mirror, and virtual.

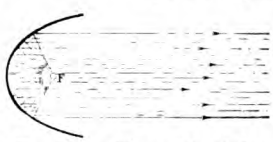


Fig. 27.—The principle of the searchlight.

Example.—In a concave mirror of focal length 20 cm., the object is placed 15 cm. from the mirror; find the position of the image.

We have $\frac{1}{15} + \frac{1}{v} = \frac{1}{20}$; $\frac{1}{v} = \frac{1}{20} - \frac{1}{15} = \frac{15 - 20}{300}$

$= -\frac{5}{300} = -\frac{1}{60}$; $\therefore v = -60$.

Hence a virtual image will appear 60 cm. behind the mirror.

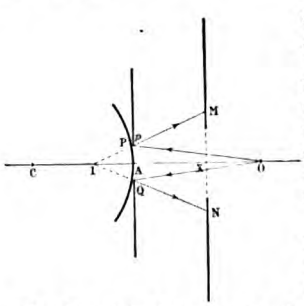


Fig. 28.—To find the focal length of a convex mirror.

Experiments.—1. Test the principle of conjugate foci.

2. Find the focal length and radius of the mirror by finding the values of u and v in several cases, and applying the formula thus:—

If $v = 16$ cm., when $u = 40$ cm., we have $\frac{1}{f} = \frac{1}{40} + \frac{1}{16}$, or $f = \frac{40 \times 16}{56} = \frac{80}{7}$

$= 11\frac{3}{7}$ cm.

3. Obtain a parallel beam of light by placing a bright light at the principal focus of the mirror. This is the principle of the searchlight: only in that case a parabolic mirror is used, as giving a more effective condensation (Fig. 27). In the spherical mirror, note that only those rays quite close to the axis really pass through the principal focus. Conversely, some of the light diverging from the focus will be more or less divergent after reflexion.

We must next consider the position of the image of a point which is not on the axis of the mirror. If we can find the place of intersection of any two rays from the point, it will be sufficient; and in making the construction we choose the two most convenient rays which are (1) one parallel to the axis which after reflexion passes through the principal focus; (2) as the second, the ray which would pass through the centre of curvature of the mirror and be reflected along the same path. We illustrate this method in Figs. 24, 25 and 26, which give the position of the image of an object of definite size, M N, placed for convenience so that N is on the axis. Draw M P parallel to O A; after reflexion the course of this ray will be P F, where F is the principal focus. Then draw M O Q to intersect P F at m. Then m will be the position of the image of M.

Fig. 25 is the case where M N is outside O. The image is small and inverted, but real. Note that it is also inverted laterally.

Fig. 26 has M N between O and F. The image is still real and inverted, but enlarged.

Fig. 24 shows M N between F and the mirror. The image is erect, virtual and enlarged.

10. Magnification.—The ratio $\left(\frac{m\ n}{M\ N}\right)$ between the size of the image and that of the object is called the magnification of the mirror. This ratio can be shown $= \frac{v}{u}$ by simple geometry in various ways.

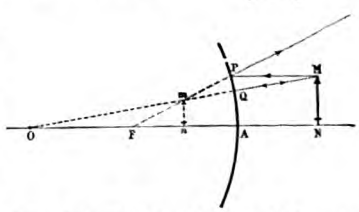


Fig. 29.—To find the position of the image on a convex mirror.

In Fig. 26, since P must be close to A, the length of P A is almost equal to that of Pa perpendicular to A F, and hence = M N.

Now the triangles P A F and m n F are equiangular and $\therefore$ similar.

$\therefore$ $m\ n : F\ n :: A\ P : A\ F$

$\therefore \frac{m\ n}{A\ P} = \frac{F\ n}{A\ F}$.

$\therefore \frac{m\ n}{M\ N} = \frac{v - f}{f} = \frac{\text{distance of image from focus.}}{\text{focal length}}$

But from the formula $\frac{1}{u} + \frac{1}{x} = \frac{1}{f}$, $f = \frac{uv}{u+v}$.

$$\therefore \frac{v-f}{f} = \frac{v - \frac{uv}{u+v}}{\frac{uv}{u+v}} = \frac{v^2}{uv} = \frac{v}{u}.$$

$\therefore$ magnifying power $= \frac{mn}{MN} = \frac{v}{u} = \frac{\text{distance of image.}}{\text{distance of object}}$

11. Convex Mirrors.—The case of convex mirrors requires consideration in one or two special respects. The formula $\frac{1}{u} + \frac{1}{v} = \frac{2}{r}$ holds good in their case, if we remember that distances measured behind the mirror are to be counted negative. As r is always negative, and u always positive, it follows that v must always be negative, and the image always virtual. And since the principal focus is behind the mirror, it follows that we cannot measure the focal length directly.

Experiment.—The focal length can be obtained indirectly as follows (Fig. 28):—

Cover the face of a convex mirror with a screen, leaving only a small circular hole P Q near the axis. Let O be a source of light on the axis of the mirror. The light falling on P Q will be reflected from the mirror and appear to diverge from the virtual image I. A screen placed as M N, perpendicular to the axis, will receive a spot of light on it, whose diameter M N can be measured. Measure also the distance A X between this screen and the mirror.

Now, the triangles I P A, I M X being similar,

I A : P A :: I X : M X.

$$\therefore \frac{PA}{MX} = \frac{IA}{IX} = \frac{v}{v + AX}.$$

In this equation, v is the only quantity that cannot be measured. Hence v can be found, and the focal length of the mirror determined.

In order to find the position of an image we proceed exactly as in the case of concave mirrors, but remembering that the principal focus is behind the mirror. Fig. 29 illustrates the method.

E. W. E.

ELECTRICITY AND MAGNETISM.—III

BEFORE a piece of steel becomes a magnet, the minute particles of which it is composed, its molecules as we say in scientific language, are arranged anyhow, with their axes pointing in any direction. After magnetisation the molecules, particularly those near the surface, are arranged in lines parallel to the length of the magnet. The number of molecules composing the bar of steel is exceedingly great, but we can illustrate the facts stated by means of a diagram showing a small number of the molecules, each very much enlarged.

The molecules appear to possess magnetic properties in themselves, and we must not imagine that anything other than orderly arrangement is given to them when we stroke the steel with the pole of a magnet. Before the linear disposition of the molecules is effected, their muddled condition prevents the bar *as a whole* from exhibiting magnetic properties.

When the bar of steel is a magnet, the molecules, which are little magnets, lie in order with the north pole of one *neutralising* the south pole of the molecule next to it, and this neutralisation is more thorough in the middle of the bar than it is at the ends, hence the unequal distribution of free magnetism in the bar. To show how unlike poles may neutralise each other and decrease the amount of

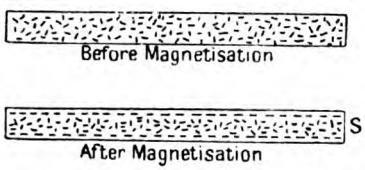


Fig. 7.—Showing the effect of magnetisation on the molecules in a bar of steel.

free magnetism, we may perform a very simple experiment.

Experiment 6.—*To see how two unlike poles interfere with the distribution of free magnetism.*

Support a key by the north pole of one magnet and then bring down slowly a south pole of another magnet upon the north pole of the first. The key falls away from the magnet. Be careful not to shake the key off; probably it will cease to adhere before the two dissimilar poles of the magnets actually come in contact.

In order to make a magnet, all we have to do is to arrange the magnetic molecules of a bar of steel in the necessary formation for the bar to exhibit free magnetism, and on pp. 332, 334 we noticed two ways of doing this, the method of single touch, and induction. If four magnets are available we can use a more effectual method of magnetisation.

Experiment 7.—*To magnetise a piece of steel by the method of Divided Touch.*

Place the steel to be magnetised upon two magnets in the way illustrated in Fig. 8. That end of the bar resting upon the N. pole of the underlying magnet will eventually be its south pole, and the direction of movement of the magnetic poles

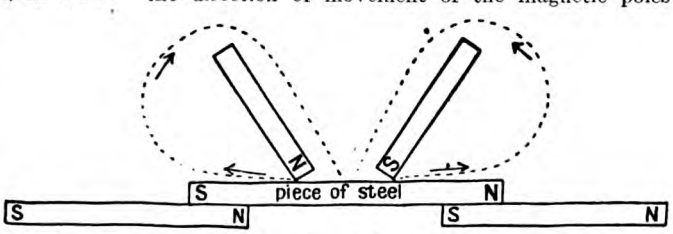


Fig. 8.—To magnetise a piece of steel by the method of Divided Touch.

rubbing the upper surface of the bar, will contribute towards that result. As the sliding magnets move in the direction indicated by arrows, they will arrange the molecules of the bar so that their south poles will face the north poles of the operating magnets. Care must be exercised to see that poles used are

of the right polarity. In this case the stroking process is begun at the middle of the bar, the magnets are moved in opposite directions, and with each repetition of the movement the magnets should be moved well away from the bar before they are brought down on the middle portion again.

By the method of single touch, one magnet, without losing any of its power, may be used to make any number of new magnets.

This shows that the operating magnet gives none of its magnetism to the pieces of steel undergoing magnetisation, but merely directs their molecules, and that the energy required for the molecular adjustment is supplied by the work done in our sliding the magnet along the steel.

The essential linear arrangement of molecules is responsible for the facts as follows:—

(1) If a magnet is divided into any number of parts, each part is a separate magnet.

(2) A piece of steel is very slightly longer after, than it was before magnetisation.

(3) Anything which upsets the necessary arrangement of molecules, such as banging the magnet or making it red hot, will destroy magnetism.

(4) The polarity of a magnet may be reversed by methods of touch or by induction.

The Magnetic Field.—We must now carefully note how far the influence of free magnetism extends in all directions through the space around a magnet. The space above, below, and around a magnet in which the influence of the magnet is at all appreciable is known as its MAGNETIC FIELD.

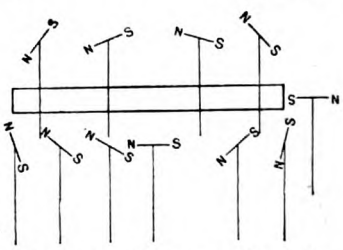


Fig. 10.—The magnetic field in a vertical plane.

Experiment 8.—*To note the extent of the field around one pole of a magnet.*

Place some iron filings on a piece of paper, hold a pole of a bar magnet above them, not near enough to catch them up, but sufficiently near to cause them to respond to movements of the pole above them.

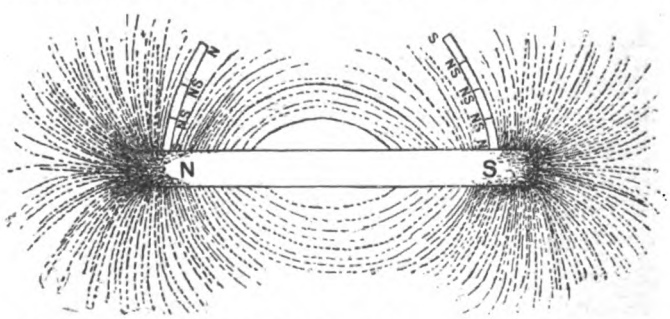


Fig. 9.—Lines of force in the horizontal plane. A few of the so-called lines show the filings magnified in order to emphasise the fact that the filings are all arranged in accordance with the law of polarity.

The filings become little temporary magnets by induction because they are *within the "field" of the inducing magnet.*

Slowly move the pole farther away from the filings until there is no response to any backward and forward movement of the magnet. The filings are then outside of the field.

Stronger magnets have larger fields; they will influence the filings at a greater distance than that at which a weaker magnet will do so.

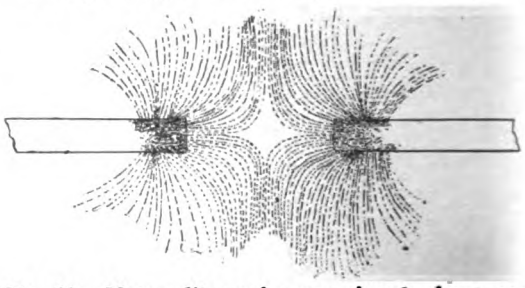


Fig. 11.—If two like poles are placed about one inch apart, the pattern obtained indicates that the greatest force in the field is one of repulsion between the two similar poles. In the space between the poles the lines are pushed aside leaving a diamond-shaped space.

Every magnet has its own field of influence, but when two or more magnets approach near enough for their fields to interfere with one another there will be a more complicated *resultant field.*

Experiment 9.—*To investigate the horizontal part of the field just above a magnet.*

Place a bar magnet under a piece of cardboard, sprinkle iron filings on those parts of the cardboard that are above and around the magnet, gently tap the board, and the filings will arrange themselves in certain curved lines, known as LINES OF FORCE.

Each filing has become a little magnet, with its poles so arranged that its north is near or touching the south pole of the next filing. In Fig. 9 one or two of the so-called lines of force show the filings magnified in order to emphasise the fact that all of them are arranged in accordance with the law of polarity. It must be understood that the lines of force indicate the paths along which filings would travel towards the magnet if they were free to move.

Experiment 10.—*To examine the field in a vertical plane passing through a magnet.*

Suspend a small magnetised needle in different positions above and below the magnet. The various angles at which the needle sets itself will indicate the direction of magnetic force in the different positions; in other words it will show the arrangement of the lines of force in a vertical plane (Fig. 10).

Our experiments make it quite clear that the distribution of magnetic force in the field is not uniform.

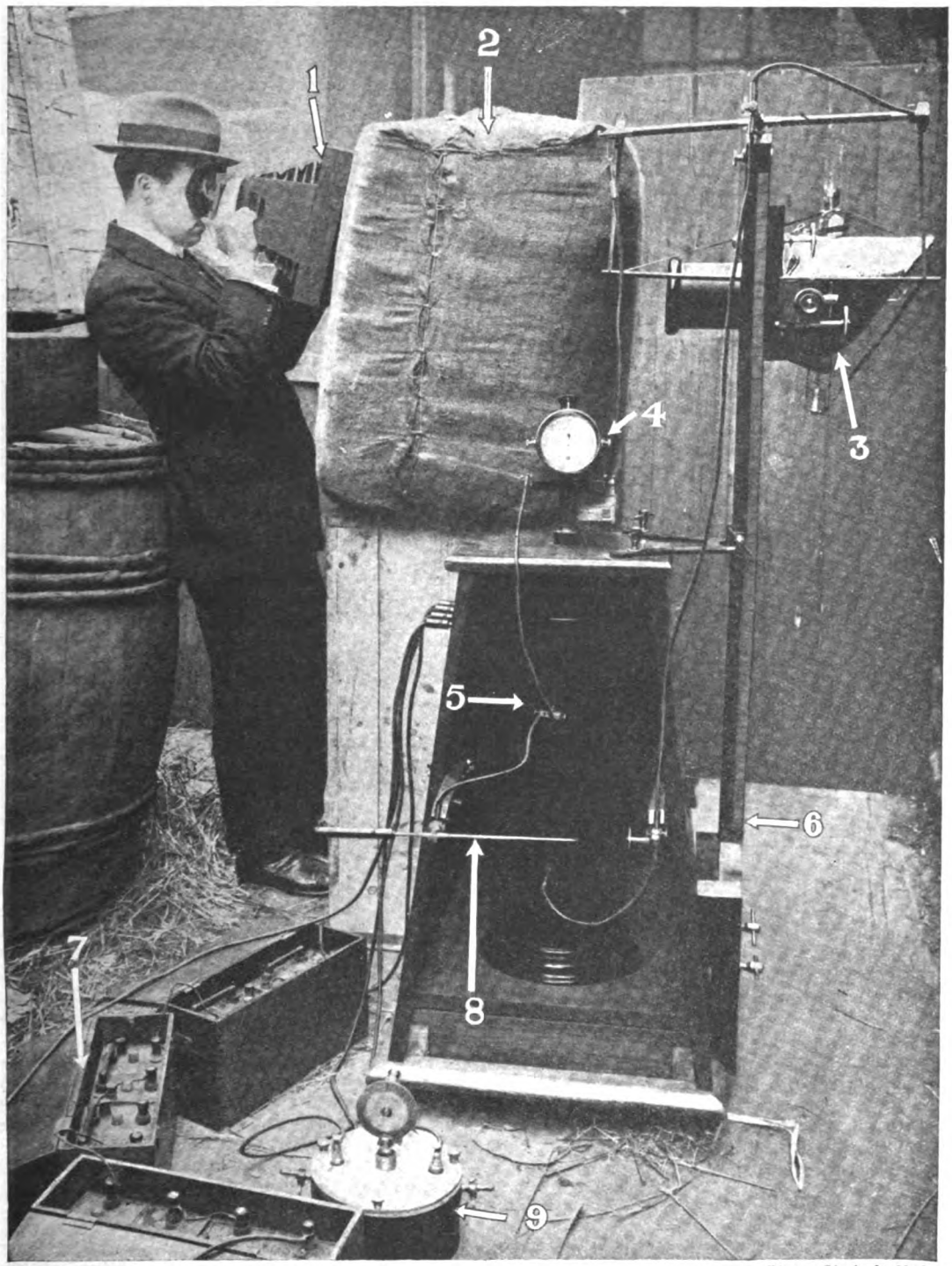


Photo: Clarke & Hyde.

ADAPTING THE X-RAYS TO COMMERCIAL PURPOSES.

Searching ships' cargoes for contraband. A device perfected during the days of the Great War. Above, a bale of cotton (2) is shown under examination. The fluorescent screen (1) would immediately show up as a silhouette copper or any other concealed substance; (3) X-rays tube, with protective shield; (4) milliampére meter; (5) Induction transformer; (6) Adjustable standard, for raising or lowering the X-rays tube; (7) Accumulators; (8) Adjustable spinter meter; (9) Interruptor.

Experiment 11.—*To examine the field between two unlike poles.*

Place two bar magnets in line with the N. pole of one about an inch apart from the S. pole of the other, place the cardboard above them and sprinkle iron filings as before. Part of the field of either magnet now *modifies* that of the other, and the greatest force in the resultant field is one of *attraction* between the two opposite poles placed near to each other.

Notice how the filings stream across the space in numerous thick lines. But if two *like* poles are placed about an inch apart, the pattern obtained indicates that the greatest force in the field is one of *repulsion* between the two similar poles.

In the gap between these poles, the lines of force are pushed aside leaving a more or less diamond-shaped space in which there is little or no magnetism. Such a space is called a ***neutral region*** **(Fig. 11).**

By varying the position of the magnets and their poles, a large number of instructive filing diagrams can be obtained; the arrangements as follow should be tried and the results explained by the reader himself:

(1) A horseshoe magnet alone.

(2) A horseshoe magnet with keeper attached.

(3) Two bar magnets arranged parallel to each other (*a*) with unlike poles at the ends, (*b*) with like poles at the ends.

(4) Two bar magnets arranged in the form of a cross.

Iron-filing diagrams of a photographic nature can be made by performing the "tapping" operation on printing-out paper, and then toning and fixing the paper.

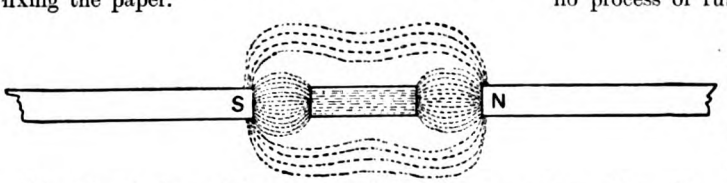


Fig. 12.—A piece of iron placed between two magnets alters the magnetic field by concentrating the lines of force within itself.

Iron in the Magnetic Field.—Let us consider the effect of introducing pieces of iron into the field of a magnet.

Experiment 12.—*To find out if iron modifies the magnetic field.*

Suspend a small magnetic needle at a little distance from the N. pole of a larger bar magnet. The smaller one being free to move, it will adjust itself so that its S. pole is opposite the adjacent N. pole of the other magnet. There is a force of attraction between the two, and this force is exerted through the air between them. Place a fairly thick piece of iron between the magnets and note that the little needle is not now under the influence of the larger magnet.

The iron alters the magnetic field by absorbing the magnetism of the stronger magnet, or in other words the iron concentrates the lines of force within itself, and the field of the small magnet is now separated from that of the other. Paper, glass, wood, or any other non-magnetic body acts in the same way as air, for when any of these materials are placed between the magnets the force of attraction still exists, since there is no alteration in the magnetic field. The absorbing property of iron may also be illustrated by placing a lump or ring of that material between two unlike poles. An iron filing diagram will illustrate the magnetism in the field **(Figs. 12, 13).** A number of lines of force flow into the iron, and in the case of the ring the internal

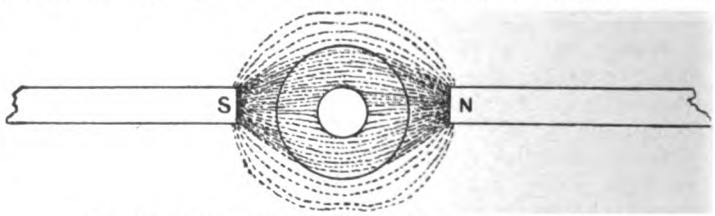


Fig. 13.—Illustrating the absorbing property of iron.

space is a neutral region. Steel would exhibit similar properties, but not to the same extent.

Iron has more power in gathering the lines of force within itself than steel has, and the fact is expressed scientifically by saying that the *Permeability* of iron is greater than that of steel.

Having studied the magnetic field to some extent we are now in a position to form a more adequate idea of the nature of induction. Whenever a piece of unmagnetised steel or iron enters any magnet field, its molecules are influenced by the magnetism that passes through it and the molecular arrangement is directed by the lines of force in that part of the field where the iron or steel is situated.

Magnetic properties are said to be induced when no process of rubbing has been employed to produce them. An iron nail or other magnetic substance may be magnetised by induction whether it is actually touching the inducing magnet or is separated from it by a space. Generally the induction influence acts across a space, in which case the material occupying the space, air, glass, india-rubber, etc., is known as the *inductive medium*. Iron being more easily influenced by induction than steel is, it is said to have a greater *Magnetic Susceptibility* than steel, but, on the other hand, since steel retains its magnetism its *Retentivity* is greater than that of iron.

Susceptibility, which is the degree of ease with which a magnetic body becomes magnetised, must not be confused with Permeability or the readiness with which a substance, magnetic or non-magnetic, allows magnetism to pass through it. The distinction becomes apparent at once, when it is realised that *non-magnetic* substances, air, paper, etc., which allow magnetism to pass through them, are permeable, but they are not susceptible to magnetic influence, otherwise they would become magnets.

L. M. P.

ZOOLOGY.—XIV

ORNITHOLOGISTS differ considerably regarding the classification of bird species.

We shall not, therefore, attempt within the short space at our disposal to do more than indicate the chief characteristics of the different orders, which, for facility of reference, we shall group under three headings: (I.) Flying Birds; (II.) Wading and Swimming Birds; (III.) Flightless Birds.

Passeres or Perching Birds

Easily the most important order that falls under the first heading is that of the Passeres or Perching Birds. This group comprises some 6,000 species, of which the different families are alike in respect of the peculiar formation of the foot, the fourth toe extending backwards to afford a "perching" grip.

The Song Thrush and its larger relative the Missel Thrush are well known in Britain. As eaters of snails and slugs both species do good service to the gardener, though it is to be feared that they are more frequently associated with their unfortunate partiality for fruit. The Song Thrush is a delightful songster. The song of the Missel Thrush, though less musical, may often be heard when a high wind is sweeping through the tree tops, a peculiarity that has earned for this bird the name of Stormcock.

The Golden Oriole is an occasional visitor to the south coast of England. His plumage is yellow and black, and his food consists of soft insects and fruit.

The Blackbird, a familiar sight in every British garden, is even more destructive to fruit than the thrush. But, like that happy songster, he also does yeoman service in destroying snails, slugs and other destructive insects. He is a clever mimic, and has been known out of pure lightness of heart to imitate the crow of the farmyard fowl. Its own note, which is full and clear, is occasionally varied by a shrill cry of alarm when something occurs to frighten it.

The Ring Ouzel, a native of Central and Northern Europe, is slightly larger than the Blackbird, which it resembles in its habits.

The Redwing has secured its name from the patch of coloured feathers which is plainly to be seen on either side when it takes to flight. This bird nests in Norway, and in regions north of the British Isles, such as Iceland, and does not make its appearance here before October.

The Fieldfare, like the Redwing, appears in these islands from its northern home in the autumn. This bird may usually be seen in consort with numbers of his fellows, for, unlike the Blackbird, he is extremely fond of the society of his own species. The Fieldfare is chestnut-coloured in the back, and has head and neck feathers of bluish-grey, and a reddish-yellow breast marked with black. The lower portion of the body is white.

The russet-brown coat and buff-white vest of the Nightingale is known to most bird lovers. For some reason that is as yet unexplained this beautiful songster confines himself in England to the south-eastern and some of the midland counties. His nest will more frequently than not be found upon the outskirts of a wood or coppice. The Nightingale arrives in England during April, and it is before the male bird has actually found his mate that he exhibits in its greatest perfection his powers of song.

Many attempts have been made to secure the Nightingale in those districts which he neglects, but though eggs placed in alien nests have actually hatched out, nothing more has been seen of the young birds after they have flown south for the winter. If they ever returned to this country, which is probable, they observed the unwritten law, the effect of which is to make the most delightful songster one of the least frequently heard in England.

Redstarts and Robins

The Redstart, a familiar summer visitor, owes his name in part to the red which forms the dominant tint in his feathers, and in part to his habit of darting suddenly in pursuit of an insect on the wing. Though not a strong singer he has a pleasing note. He nests usually in a crevice in a wall.

The Robin, or Redbreast, is to be seen in Britain throughout the year, though it does not follow that the Robin of the winter months is the same Robin that was to be seen in the preceding summer. Some of the species, in fact, enter the country just as others are leaving it, and even those that remain are not constant to one spot.

The Robin is peculiarly fearless. He appreciates a diet of worms, is addicted to berries and insects, and does not hesitate when these luxuries are not forthcoming to enter an open door in search of a crumb or two from the kitchen table. His nest, which is composed of leaves and moss lined with debris and feathers, may be found in a wall or bank or in the hollow of a tree, or

DIPPER.

Photos: Jasper Atkinson.

WHEATEAR HEN.

if not in some such orthodox place, in any unexpected spot, such as in the eaves of a house or even in an old tin.

The Whinchat, with his brown coat marked with black, his white streaked face, and his yellow white body may occasionally be found in Britain in the winter, but most generally leaves these shores during the autumn. The Stonechat, darker about the face, is more regular in his migratory habits.

The Wheatear is one of our earliest visitors, for he is to be found feeding upon marine insects near our coast resorts early in March. Later in the season, however, he travels inland. By the close of September he has left again for his warm winter quarters.

The Hedge Sparrow has few claims to distinction, though as a permanent resident he is perhaps entitled to greater consideration than such birds as the Redwing, who regard this country merely as a pleasant winter resort. Though an early builder he is a careless one, and seldom goes out of his way to choose a concealed spot for his nest. The Hedge Sparrow, who should not be confused with the grain-eating true sparrow, feeds upon insects, worms and seeds.

The Mocking Bird, or American Thrush, is a member of the Thrush family, not to be found in a wild state in Britain. His plumage is grey, marked with black and white and brownish white below. He is a born mimic, and in exercising his art he displays such extraordinary skill that both man and beast are his constant victims. He will bark like a dog, whistle like a man, and cry like a hurt chicken.

The Warblers are a family the members of which are generally migratory. As a rule, they are of slighter build than the members of the Thrush family. Great Britain is the summer resort of twelve members of this group, amongst them being the Blackcap, Whitethroat, Chiffchaff, Wood

Photo: F. C. Milton.

MISSEL THRUSH.

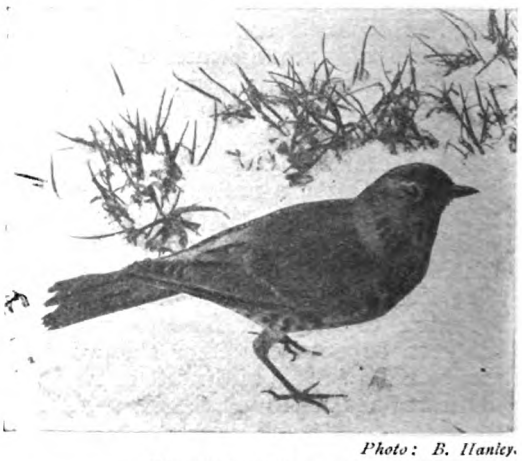


Photo: B. Hanley.

FIELDFARE (in snow).

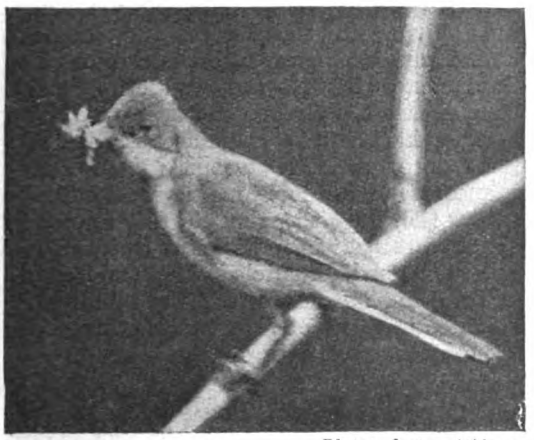


Photo : Jasper Atkinson.

WHITETHROAT.

Photo : F. C. Milton.

GARDEN WARBLER.

Wren, Willow Warbler, Garden Warbler, and the Sedge and Reed Warblers. All the Warblers are insect eaters.

The Blackcap is olive-grey above and grey beneath, and is conspicuous by the black cap in which the male bird covers the top of the head. This cap in the female, however, is chocolate coloured. By preying upon the fruit-eating caterpillars the Blackcap does useful service.

The Greater Whitethroat, like the Blackcap, derives his name from a distinguishing portion of his plumage. Elsewhere than on the throat and lower body he is a reddish-grey in colour. The Lesser Whitethroat is a grey-and-brown bird slightly smaller than the Greater Whitethroat.

The Chiffchaff, who is one of the earliest of the Warblers to reach this country, derives his name from his peculiar cry. His coat of olive-green dashed with yellow is practically the same as that of the Wood Wren.

The Garden Warbler is to be found practically throughout the country, the Reed Warbler may be heard from April till September in the Midlands and South of England, but not in Scotland or Ireland. The Sedge Warbler is to be seen wherever the Reed Warbler is found.

The Tailor Bird, an Indian resident, is one of the most ingenious of the Warbler family. By the aid of his long bill he sews together two broad leaves in such a fashion as to make a pocket in which to build his nest.

The Dipper, or Water Ouzel, to be found in Britain, is one of a family widely spread throughout Europe, the Americas and Asia. The British representative is to be met with in the vicinity of certain pools and streams, in which his diving abilities are displayed to great advantage. When searching under water for the insects which form his food, the Dipper, like the Guillemot, uses his wings to propel himself along. A. B.

BLACKBIRD.

Photos : F. C. Milton.

ROBINS : mother and family.

ETHNOLOGY.—II

THE gun, as we have already seen (p. 344), represents one of the first utilisations of gas, of the power of rapid expansion in certain metals. Somewhere in the remote Middle Ages monkish investigators (always in terror of prosecution for sorcery) found that the fusion of charcoal and saltpetre produced a powerful exploding powder.

Others again conceived the idea of enlisting this force to expel projectiles through tubes. The " projectile " idea arose in the sling of rubber or the reed blowpipe. Machinery for hurling stones had been invented more than 2,000 years ago by the Romans and other military peoples ; but the force used was that of some released spring—a development of man's first toying with the twig and the flexible rind of palm stems, the viscid sap of rubber lianas or the guts of dead beasts.

Modern Artillery

Having obtained this detonating force of the gas generated by what we now know as gunpowder, man applied it to the cross-bow and shot his bolt ; not by the twanging of a taut string, but by the explosion caused by applying fire to saltpetre and charcoal. Other tube ideas grew into the cannon, into the monsters that, in the twentieth century, have devastated Europe and destroyed in an hour fortified cities or magnificent cathedrals.

A more primitive weapon more easily connected with the Stone Age remains to us in the bayonet, though the sword in civilisation is passing out of use. But weapons have branched off into surgical implements and the implements for drilling, mining and manufacture, which are surrounding our lives with marvels of ingenuity.

Evolution of Music

Then again, take the ethnological history of music. The very anthropoids are fond of singing. The loud singing of the gibbons is one of their most noteworthy characteristics. Chimpanzis shout a kind of song in the forest (or when they are in very good spirits, in captivity) till it sends them into a kind of hysteria and ends up with mad, shrieking laughter. They likewise drum with their closed fists on hollow tree trunks, and in captivity delight to clang metal.

Early Man must have had the same in-

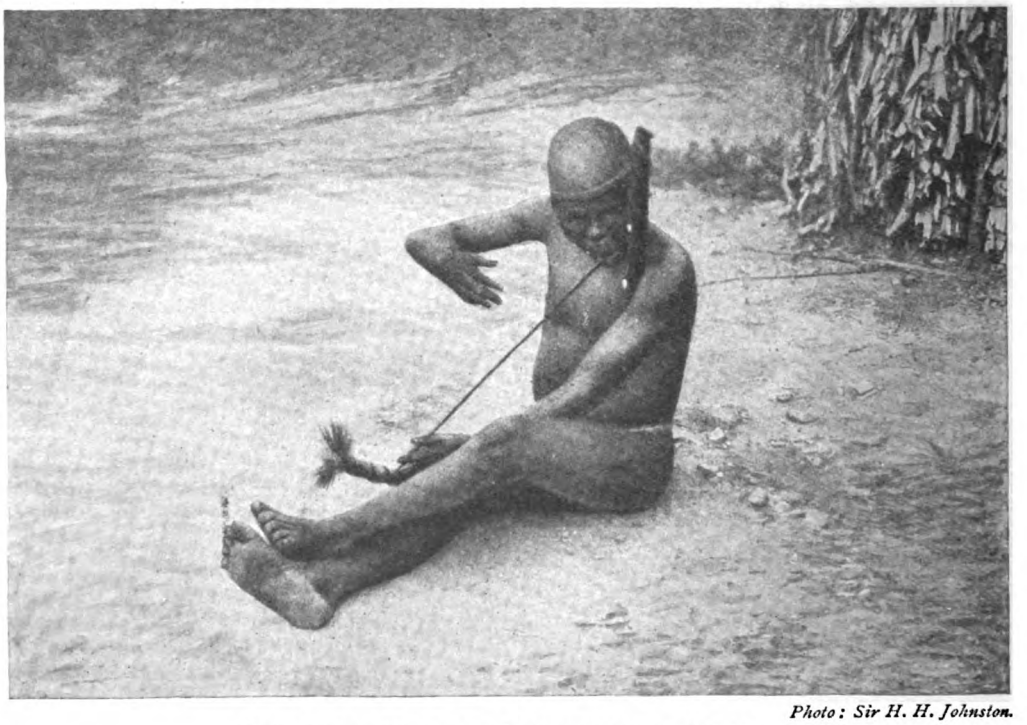


Photo : Sir H. H. Johnston.

THE SINGLE-STRINGED INSTRUMENT OF MUSIC,

from which all string instruments were evolved, being played upon by a native of the Ituri district, Belgian Congo.

stincts and longings. As in everything else, he applied himself to the gratification of them by artificial means. He soon ceased to drum with his fists in preference to striking resonant wood with a club or to rattle stones or hard seeds in a hollow gourd.

As soon as he had invented the bow out of the snare (by tying to two ends of a supple twig, tense palm-rind, twisted gut or twisted fibre) he experienced the joy of twanging the bowstring. The earliest stringed instrument, in fact such as may be seen in the heart of Africa at the present day, and was formerly to be observed amongst the Bushmen, is the "musical bow," the bow with the single string, which is made further melodious by the use of the lips, teeth and voice.

From the musical bow—the single-stringed instrument of music—arose in course of time the lyre, the harp (a bow with the strings multiplied lengthwise), the fiddle, banjo, guitar, zither, and finally the piano itself, with the strings multiplied broadwise; that is to say, the one arose from multiplying the strings inside the arc of the single bow, and the others from tying a number of bows side by side.

The sounding of this last was improved by introducing some hollow cylinder, like a tortoise-shell or half a gourd.

The drum, mainly based on the resonance of hollow wood, assumed several different forms. The earliest, perhaps, was the hollow, natural cylinder of the segment of a scooped-out trunk, with some snake's, lizard's, or beast's skin stretched over the ends; or over one end whilst the other was blocked more solidly. Then there was the gong, first of wood and next of metal, in which another great slice of a trunk has only one opening, and that more or less of a slit at the side.

From this arose the remarkable signalling drums of Africa, the sound of which can travel for several miles. The reed or bamboo with slits and holes in it, became first the flute and then the pan-pipe (several reeds placed in a row). The idea later being translated into metal gave birth to a great variety of musical instruments, culminating in the organ, which is little else than the gigantic descendant of the pan-pipe. The whistle was a hollow twig with a cunning hole or slit at the end, and has grown into the fife and the concertina. Leather bags attached to

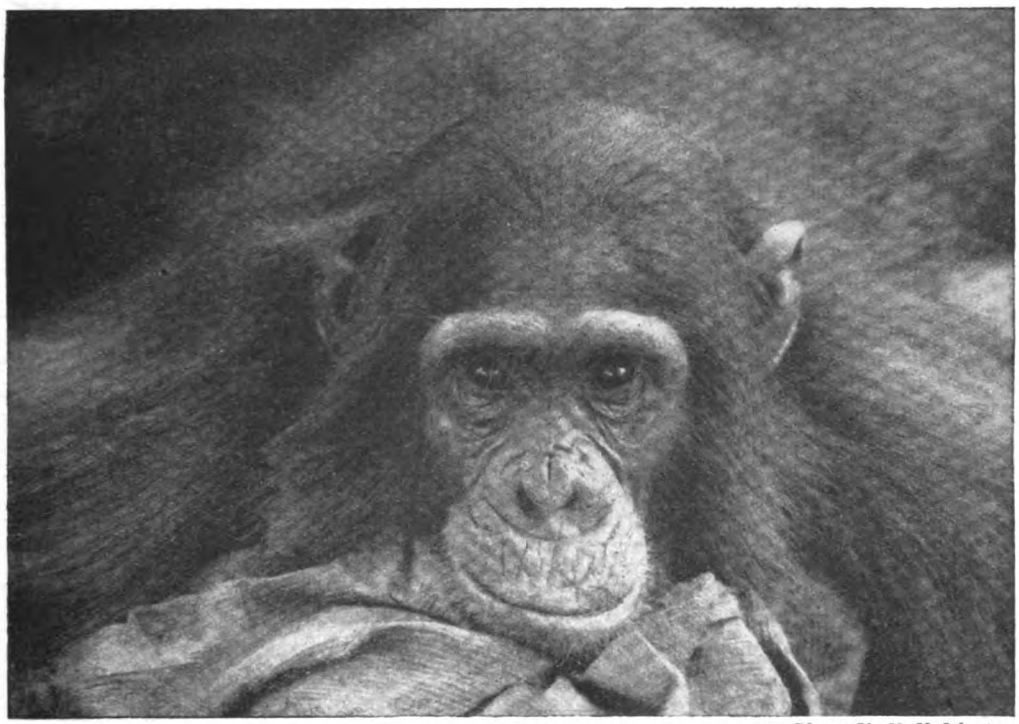
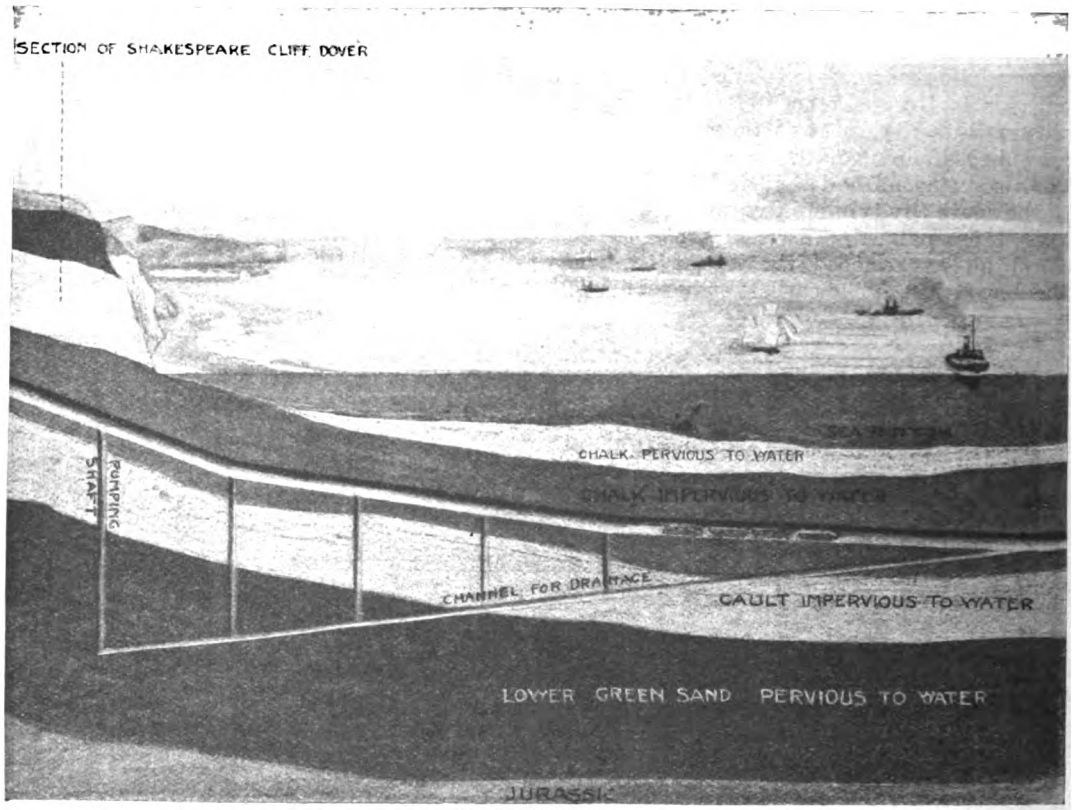


Photo: Sir H. H. Johnston.

THE UGANDA CHIMPANZEE.

A gibbon possessing a marked, if crude, sense of music; he has his own forest song, drums on the bark of hollow trees, and in captivity delights to clang metal.



FROM DOVER

Showing the course of the proposed Channel Tunnel and the strata to be pierced. This engineering has been bored for some distance under the Channel. Political and

these very forms of whistle, flute, or pan-pipe, produced many musical instruments, such as, for example, the bagpipes.

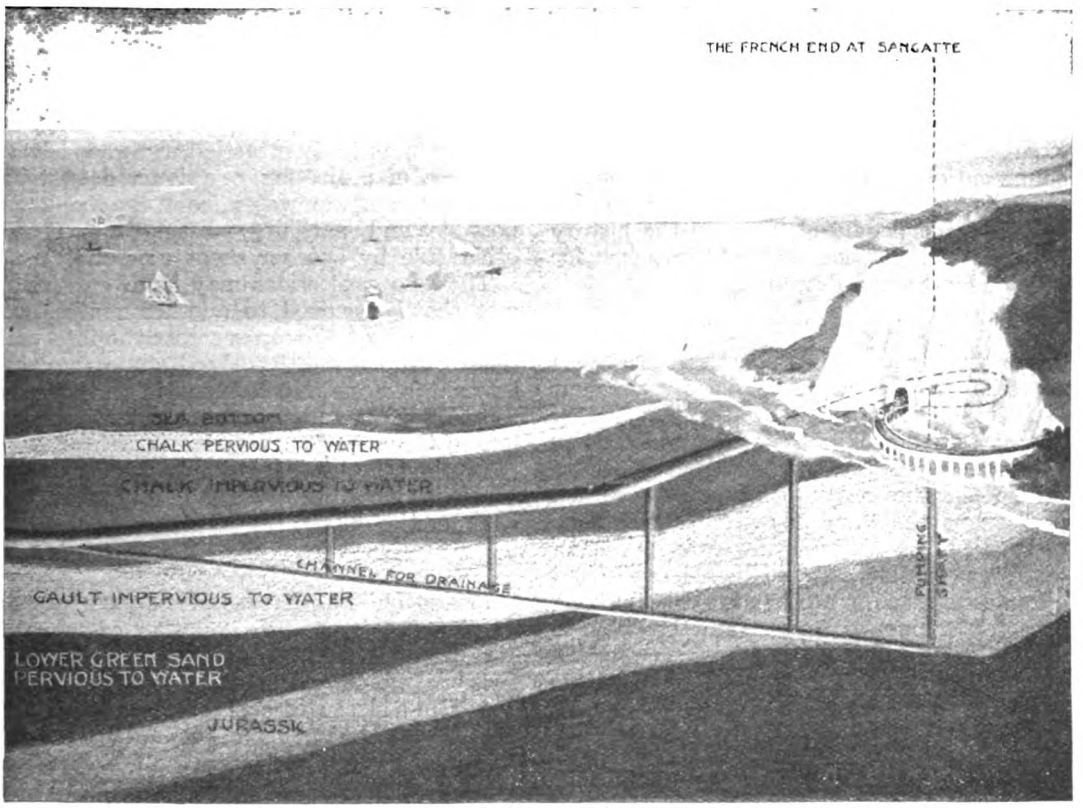
In some countries they first of all shaped smooth, flat tongues of hard wood and fixed them over hollow signalling drums, gourds or tortoise-shells, and twanged them with the fingers or with a plectrum held in the fingers; or struck them with wooden hammers. First wood and then metal. From a combination of these ideas—the wooden sounding-board, the harp laid on its side, the wires struck with hammers and not with fingers—arose the harpsichord or piano, perhaps on the whole the most dearly loved, the most pleasure-giving of all instruments invented by man, the easiest to play, the most complicated in structure and the most foolishly named, since its full term in Italian —pianoforte—means "soft and loud"!

Man's voice has been similarly cultivated, differentiated, modulated, educated, till its range of sound and expression is marvellous when we compare it to the hoarse cries, piercing shrieks and stupid bellows of the Ape. There has been some degree of sex differentiation in this respect, much greater than is observable in apes and baboons; there is the high-pitched treble voice of the woman and the boy, and the deep bass of the grown man; with, in between, the delicious tones of the mezzo-soprano, contralto, alto, tenor, and baritone.

These extremes and these fine shades are not quite so marked amongst the savage peoples, with whom the tendency on the whole is for the voice to be higher pitched than amongst Europeans; contralto in a woman and bass in a man is rare in the savage Asiatic, Amerindian, or Negro.

Du Maurier, that seer-novelist, guessed that in these experiments in sound, this growing mastery over air vibrations which we call music and song, man was more likely to get into communion with God than through any other channel, because of the effect of these air vibrations on the mind of that mysterious Something which for a time emanates from and lives in the brain.

Then take the development in human history of engineering, and see what it has led to; how the first attempts of the savage



TO SANGATTE

work was actually begun some years ago, and both from the French side and the English side a tunnel strategic considerations alone have delayed the completion of the work.

anthropoid to dam up a diminishing rill of water, or to divert a stream from where it was uselessly wasted to where it might provide moisture for man, beast, and edible plant ; or the first intelligent efforts to make a bridge by flinging a tree across a stream have brought us to the irrigation of vast deserts and the bridging of broad straits. Think what the development of water storage and irrigation has meant to the world ! From it probably arose the marvellous civilisation of Egypt 10,000 years ago.

Earlier than that, the Neolithic white man in Arabia (and earlier still in West-central Asia) had noticed with pain and anxiety the lessening rainfall, the increasing aridity, the withering of vegetation, the departure of useful wild animals. He set himself to work to dam with stones and mud such sources of water supply as remained, especially in the mountains of Arabia.

Several thousand years—or it may have been only centuries—spent in damming, in constructing, in drilling stone, in making conduit pipes and fortresses to guard the treasured wells or reservoirs. resulted in the birth of what we call Egyptian civilisation. For the fight against climate in Arabia was on the whole a losing battle ; such water supply as there was would only irrigate enough land to feed a fixed number of people. Tribal wars arose from this cause, and many a defeated or a victorious tribe decided to leave a land where life was so hardly won and departed to more fertile regions.

In clear weather across the warm blue water of the Red Sea they could distinguish the mountain peaks of Abyssinia ; and it may also have been that in those not very distant days the Straits of Bab-al-Mandib were narrower than they are now. At any rate, the Neolithics of Western Arabia were well aware that the Red Sea was bounded by a great continent on the other side, and that this continent from its snow-tipped mountains promised a better water supply than they could find in Western Arabia.

So, with their great knowledge of how to deal with stone as quarriers and builders, they crossed to the western Red Sea coast, and finding that scarcely better than arid Arabia, they pushed their way northwards

and westwards over the stony, scrubby hills till they reached the great and ever flowing river reported to them by the natives. Once in the Valley of the Nile (first where it flowed through stony desert and later where it expanded over a vast mud delta) their command over stone, the cutting, the manipulating, the placing of stone, led to one of the most splendid chapters in the history of human civilisation and left its mark for all time on human development.

Bridge Building

The tree trunk thrown across the stream was the first bridge of man's arrangement —Nature having pointed the way by many a tree cast down in gales or uprooted by torrents. But Nature suggested the Brooklyn bridge and the marvellous structure which now spans the Zambesi where Livingstone discovered the Victoria Falls. Man-in-the-grain as monkey, and later as ape, had often crossed a broadish river by climbing up some leaning tree trunk and branch, the foliage or parasitic lianas of which mingled with the branches and creepers of a tree sloping from the opposite side.

It soon occurred to early Man, where the connection was not very safe or sufficient, to unite the two with coils of these abundant, tough, and supple climbing plants. At last he learnt to make rude suspension bridges in wood, an idea after a great interval of time translated into metal.

Where wood was not available, and trees did not grow tall enough or near enough to the banks of great rivers, the natural stepping-stones in dry seasons suggested to him the casting in of rock fragments to form in course of time the piers of bridges. One day a genius in construction work conceived the idea of projecting one long, flat stone as far across the water from the bank as possible and partially meeting it on the other side by another shoot of stone.

The two projections may have so nearly met that it occurred to another genius, not merely to lay tree trunks across the interval, but to drop a rightly shaped stone *into* the interval, a stone that lessened in width from top to bottom and thus was prevented from falling through.

In short, he invented the keystone of the arch, an invention which no doubt was often repeated in different localities.

The Channel Tunnel

Bridge building has so developed nowadays that it is purely a question of money. It is only the doubt whether the expenditure is worth while which prevents our depositing blocks of concrete on the bed of the English Channel and erecting a series of suspension bridges across the Straits from Dover to Calais.

The alternative to such a plan would be a tunnel under the bed of the Channel, a feat in construction which is only held back by political and strategical conditions and not by any natural difficulties. H. H. J.

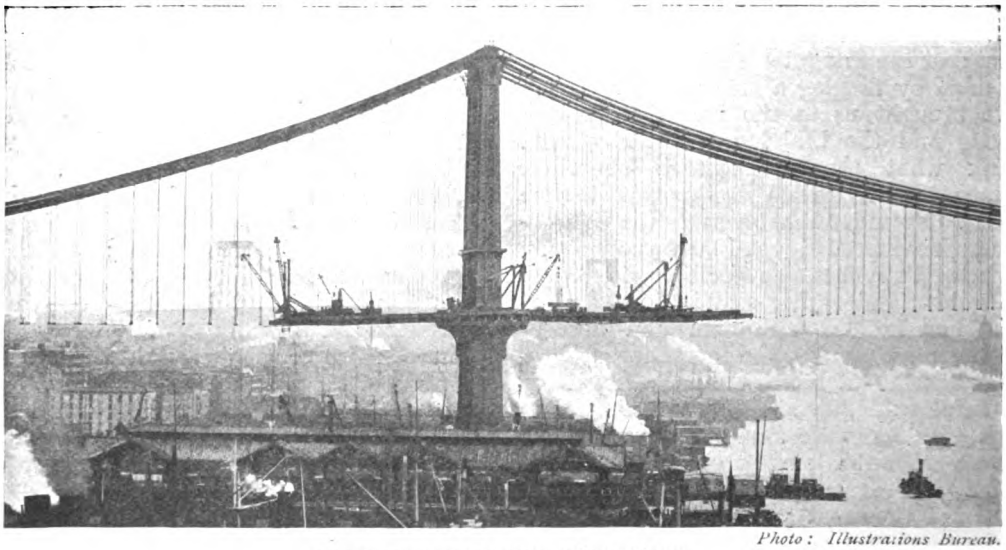


Photo: Illustrations Bureau.

MANHATTAN BRIDGE, NEW YORK,

in course of construction. In the building of this bridge, one of the engineering wonders of the world, some 40,000 tons of steel were used.

Continued from page 354.

LANGUAGES:

Contributors:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A.[Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).

LATIN.—XV

Irregular Verbs

THERE now remains to be studied a few irregular verbs which deviate from the normal forms according to no fixed rule, and must, therefore, be learned one by one. Some form their tenses from more than one stem; others undergo changes of form peculiar to themselves.

I. Compounds of Sum

You have already learnt how to conjugate **sum**, *I am*. The following compounds are conjugated in the same way:—

PRES. INDIC.	PERFECT.	INFINITIVE.	
absum	āfŭī	ăbessĕ	*to be absent.*
adsum	adfŭī	ădessĕ	*to be present.*
dēsum	defŭī	dēessĕ	*to be wanting.*
insum	infŭī	ĭnessĕ	*to be in.*
intersum	interfŭī	intĕressĕ	*to be between* or *present.*
obsum	obfŭī	ŏbessĕ	*to be in the way.*
praesum	praefŭī	praeessĕ	*to be in front* or *in command.*
prōsum	prōfŭī	prōdessĕ	*to be serviceable.*
subsum	subfŭī	sŭbessĕ	*to be under.*
sŭpersum	sŭperfŭī	sŭpĕressĕ	*to survive.*

Note that **prosum** always takes **d** before **e**, the present indicative being:—

Sing.	*Plur.*
1. prōsum	prōsŭmŭs
2. prōdĕs	prōdestĭs
3. prōdest	prōsunt

The imperfect indicative is **prōdĕram**, etc., and the future indicative **prōdĕrō**, etc. **Absum** and **praesum** have present participles **absens**, *absent*, and **praesens**, *present* (gen-**entĭs**). The former verb usually drops the **b** when before **ī**, lengthening the **a**, as in **āfŏrĕ**, **āfŭī**.

Possum, *I am able, I can*, consists of the base of the adjective **pŏt-ĭs**, *able*, and sum, and is conjugated as follows:—

Chief parts:—**possum**, **possĕ**, **pŏtŭī**.

Indicative Mood

PRESENT.	IMPERFECT.	FUTURE.
pos-sum	pŏtĕram	pŏtĕro
pŏtĕs	pŏtĕrās	pŏtĕrīs
pŏtest	pŏtĕrāt	pŏtĕrīt
possŭmŭs	pŏtĕrāmŭs	pŏtĕrīmŭs
pŏtestĭs	pŏtĕrātĭs	pŏtĕrītĭs
possunt	pŏtĕrant	pŏtĕrunt
PERFECT.	**PLUPERFECT.**	**FUTURE PERFECT.**
pŏtŭī, etc.	pŏtuĕram, etc.	pŏtŭĕrō, etc.

Subjunctive Mood

PRESENT.	IMPERFECT.
pŏssim, etc.	possem, etc.
PERFECT.	**PLUPERFECT.**
pŏtŭĕrĭm, etc.	pŏtŭissem, etc.

Imperative Mood

None.

Infinitive Mood

PRESENT.	PERFECT.	FUTURE.
possĕ	pŏtŭissĕ	None.

Participle

potens, gen. potent-ĭs (only as an adjective, *powerful*).

The tenses not given above in full are conjugated like the corresponding tenses of **essĕ**, *to be*; in fact, in all irregular verbs the tenses formed from the perfect or supine base are conjugated regularly.

II. Volo, Nolo, Malo

Chief parts:—

vŏlō, vŏlŭ-ī, vellĕ, *to be willing, to wish.*
nōlō, nōlŭ-ī, nollĕ, *to be unwilling, to wish not.*
mālō, mālŭ-i, mallĕ, *to be more willing, to prefer.*

Indicative Mood

PRESENT.		
vŏlō	nōlō	mālō
vīs	nōn vīs	māvīs
vult	nōn vult	māvult
vŏlŭmŭs	nōlŭmŭs	mālŭmŭs
vultĭs	nōn vultĭs	māvultĭs
vŏlunt	nōlunt	mālunt

	IMPERFECT.	
vŏlēbam	nōlēbam	mālēbam
vŏlēbās	nōlēbās	mālēbās
vŏlēbăt	nōlēbăt	mālēbăt
vŏlēbāmŭs	nōlēbāmŭs	mālēbāmŭs
vŏlēbātĭs	nōlēbātĭs	mālēbātĭs
vŏlēbant	nōlēbant	mālēbant
	FUTURE.	
vŏlam	nōlam	mālam
vŏlēs	nōlēs	mālēs
vŏlĕt	nōlĕt	mālĕt
vŏlēmŭs	nōlēmŭs	mālēmŭs
vŏlētĭs	nōlētĭs	mālētĭs
vŏlent	nōlent	mālent
	PERFECT.	
vŏlŭī	nōlŭī	mālŭī
	PLUPERFECT.	
vŏlŭĕram	nōlŭĕram	mālŭĕram
	FUTURE-PERFECT.	
vŏlŭĕrō	mālŭero	mālŭĕrō

Subjunctive Mood

	PRESENT.	
vĕlim	nōlim	mālim
vĕlīs	nōlīs	mālīs
vĕlĭt	nōlĭt	mālĭt
vĕlīmŭs	nōlīmŭs	mālīmŭs
vĕlītĭs	nōlītĭs	mālītĭs
vĕlint	nōlint	mālint
	IMPERFECT.	
vellem	nollem	māllem
vellēs	nollēs	māllēs
vellĕt	nollĕt	māllĕt
vellēmŭs	nollēmŭs	mallēmŭs
vellētĭs	nollētĭs	mallētĭs
vellent	nollent	mallent
	PERFECT.	
vŏlŭĕrim, etc.	nŏlŭĕrim, etc.	mālŭĕrim, etc.
	PLUPERFECT.	
vŏlŭissem, etc.	nŏlŭissem, etc.	mālŭissem, etc.

Imperative Mood

	PRESENT.	
None.	nōlī, nōlītĕ	None.
	FUTURE.	
None.	nōlītō, nōlītō nōlītōtĕ, nōluntō	None.

Infinitive

	PRESENT.	
vellĕ	nollĕ	mallĕ
	PERFECT.	
vŏlŭissĕ	nŏlŭissĕ	mălŭissĕ

Present Participle

vŏlens, vŏlentĭs	nōlens, nōlentĭs	None

There is no supine or parts formed from the supine base, and no gerund.

Nōlō is a contraction of **nē**, *not*, and vŏlō; **mālō** of **măg-**, base of **măgĭs**, *more*, and vŏlō.

In accordance with the usage avoiding the use of **u** after **v** or **n**, **vult** and **vultĭs** appear in some Latin texts as **volt** and **voltĭs**.

Sī vīs, *if thou wilt* (*if you please*) is sometimes contracted to **Sīs**.

Deponent Verbs

The deponent verbs of the first declension all follow the model of **hortor**. The following are those of the other declensions that deviate from the regular models :—

Second Conjugation

PRESENT.	PERFECT.	INFINITIVE.	
rĕŏr	rātŭs sum	rērī	*think.*
fătĕŏr	fassŭs sum	fătērī	*confess.*
cōnfĭtĕŏr	cōnfessŭs sum	cōnfĭtērī	*confess.*

Third Conjugation

amplectŏr	amplexŭs sum	amplectī	*embrace.*
ădĭpiscŏr	ădeptŭs sum	ădĭpiscī	*obtain.*
frŭŏr	fructŭs (or frŭĭtus) sum	frŭī	*use, enjoy.*
fungŏr	functŭs sum	fungī	*perform (a task).*
grădĭŏr	gressŭs sum	grădī	*walk.*
aggrĕdĭŏr	aggressŭs sum	aggrĕdī	*attack.*
lābŏr	lapsŭs sum	lābī	*slide.*
lŏquŏr	lŏcūtŭs sum	lŏquī	*talk.*
mŏrĭŏr	mortŭus sum	mŏrī	*die.*
nītŏr	nīsŭs or nixŭs sum	nītī	*rest upon, strive.*
pătĭŏr	passŭs sum	pătī	*allow.*
perpĕtĭŏr	perpessŭs sum	perpĕtī	*bear.*
complectŏr	complexŭs sum	complectī	*embrace.*
quĕrŏr	questŭs sum	quĕrī	*complain.*
sĕquŏr	secūtŭs sum	sĕquī	*follow.*
ūtŏr	ūsŭs sum	ūtī	*use.*

Having inceptive forms in the present :—

ăpiscor	aptus sum	apiscī	*get.*
commĭniscŏr	commentŭs sum	commĭniscī	*contrive.*
dēpĕtiscŏr	dēpessŭs sum	dēpĕtiscī	*grow weary*
expergiscŏr	experrectŭs sum	expergiscī	*awake.*
īrascŏr	īrātŭs sum	īrascī	*be angry.*
nanciscŏr	nactŭs or nanctus sum	nanciscī	*get.*
nascŏr	nātŭs sum	nascī	*be born.*
oblīviscŏr	oblītŭs sum	oblīviscī	*forget.*
păciscor	pactŭs sum	păciscī	*make a compact.*
prŏfĭciscor	prŏfectus sum	prŏfĭciscī	*start, set out.*
rĕmĭniscŏr		remĭniscī	*recollect.*
ulciscŏr	ultŭs sum	ulciscī	*avenge.*
vescor		vescī	*feed oneself.*

Fourth Conjugation

assentĭŏr	assensŭs sum	assentīrī	*assent.*
expĕrĭŏr	expertŭs sum	expĕrīrī	*try.*
oppĕrĭŏr	oppertŭs or opperītŭs sum	oppĕrīrī	*wait, await.*
mētĭŏr	mensŭs sum	mētīrī	*measure.*
ordĭŏr	orsŭs sum	ordīrī	*begin.*
orĭŏr	ortŭs sum	orīrī	*rise.*

Semi-Deponent Verbs

There are a few verbs having a passive form with an active meaning in the perfect tenses only, and therefore called Semi-Deponent or Neuter-Passive verbs :—

SECOND CONJUGATION

PRESENT.	INFINITIVE.	PERFECT.
audeo, *I dare.*	audērĕ	ausŭs sum, *I have dared.*
gaudĕō, *I rejoice.*	gaudērĕ	gāvīsŭs sum, *I have rejoiced.*
sŏlĕō, *I am wont.*	sŏlērĕ	sŏlĭtŭs, *I have been wont.*

THIRD CONJUGATION

fīdō, *I trust.*	fīdĕrĕ	fīsŭs sum, *I have trusted.*
confīdō, *I confide.*	confīdĕrĕ	confīsŭs sum, *I have confided.*

There remain to be considered three classes of verbs having a special termination expressing a special meaning. These are desiderative, inceptive, and frequentative verbs.

Desiderative Verbs

Desiderative verbs, expressing desire of the action denoted by the simple verb, are formed by adding **-ŭrĭō** to the supine base of the simple verb, as **ēsŭrĭō**, *I desire to eat*, or *I am hungry*, from **ēsum**, supine of **ĕdō**, *I eat*, or **scriptŭrĭō**, *I long to write*, from **scriptum**, supine of **scrībō**, *I write.*

These belong to the fourth conjugation forming their perfect tenses and supines on the model of **audĭō**.

Inceptive Verbs

Inceptive or inchoative verbs, expressing the beginning or increase of the action denoted by the simple verb, are formed by adding **-ascō**, **-escō**, or **-iscō**, to the base of a simple verb or of a substantive or adjective, as follows :—

lăbascŏ, *I begin to totter*, from lătārĕ, *to totter.*
ardescō, *I become inflamed*, from ardērĕ, *to burn.*
obdormiscō, *I fall asleep*, from dormīrĕ, *to sleep.*
senescō, *I grow old*, from sĕnex, *old man.*
dulcescō, *I become sweet*, from dulcīs, *sweet.*

Inceptive verbs usually have for perfect and supine those of the simple verb from which they are derived. They are principally formed from verbs of the second conjugation, but are conjugated on the model of **lĕgō.**

Frequentative Verbs

Frequentative verbs, expressing the repetition of an action, are formed by adding **-ĭtō** to the present base or the supine base of the simple verb or simply by adding the personal endings of a verb to the supine, as follows :—

clămĭtō, *I shout loudly* or *often*, from clămō, *I shout.*
rŏgĭtō, *I keep on asking*, from rŏgō, *I ask.*
ventitō, *I come frequently*, from ventum, supine of vĕnĭō, *I come.*
lectĭtō, *I read often*, from lectum, supine of lĕgō, *I read.*

Frequentative verbs are always conjugated like **ămŏ**, **ămŏr.**

Exercise 14

Translate into English :—

1. Tempora mutantur, nos et mutamur in illis. 2. Vires acquirit eundo. 3. Vir sapit qui pauca loquitur. 4. Cetera desunt. 5. Sum quod eris, fui quod sis. 6. Populus vult decipi. 7. Non progredi est regredi. 8. Vincit qui patitur.

Translate into Latin :—

1. Let it pass for what it is worth (let it be good for as much as it can). 2. Poets wish to do (us) good or to delight (us). 3. We who are about to die salute thee. 4. The voice heard perishes, the written word (letter) remains. 5. No one is born without faults. 6. If you desire peace, prepare for war. 7. Truth is said to be the daughter of time. 8. Trivial anxieties speak, great ones are mute.

Key to Exercise 13

1. All the forces of the Samnites attained the neighbouring mountains in flight. 2. Let us adopt the ancestral courage and virtue. 3. I at least do not cease to urge peace. 4. I understood from your letter that you have heard from Turannius. 5. The unendurable intensity of the heat afflicts the body of almost every one. 6. It is legitimate to learn even from an enemy.

1. Faber est quisque fortunae suae. 2. Magna est vis consuetudinis. 3. Iudex damnatur quum nocens absolvitur. 4. Humani nihil a me alienum puto. 5. Quem Iuppiter vult perdere prius dementat. 6. Possunt quia posse videntur.

E. A. B.

FRENCH.—XV

Verbs (*continued*).—THE tenses are the forms showing the time at which the action or event referred to takes place. The principal tenses are three—the present, the past, and the future. There is naturally only one present tense ; but the other tenses have different forms expressing the particular degrees in which the action of the verb is past or future. The past tense has the following varieties—the imperfect, the past definite, the past indefinite, the pluperfect, and the past anterior. The future has the future simple and the future perfect.

The Present.—The present tense shows that the action is taking place at the time of speaking, as **je chante maintenant,** which may be rendered either *I sing now*, or *I am singing now.* The following is a summary of the present indicative of the four regular conjugations :—

je	chante	finis	reçois	rends
I	*sing*	*finish*	*receive*	*render.*
tu	parles	chéris	aperçois	vends
thou	*speakest*	*cherishest*	*perceivest*	*sellest.*
il	donne	fournit	perçoit	tend
he	*gives*	*furnishes*	*perceives*	*tends.*
nous	cherchons	punissons	concevons	entendons
we	*seek*	*punish*	*conceive*	*hear.*
vous	portez	saisissez	devez	perdez
we	*carry*	*seize*	*owe*	*lose.*
ils	aiment	unissent	deçoivent	mordent
they	*love*	*unite*	*deceive*	*bite.*

The Imperfect.—The imperfect tense expresses a past action regarded as not yet completed when another action took place, as in—

Je parlais ce matin quand vous êtes entré, — *I was talking this morning when you came in.*

Je passais hier quand elle m'a appelé, — *I was passing yesterday when she called me.*

The imperfect is also used to express an habitual or often repeated action, as in—

L'année dernière j'allais tous les jours à l'école, — *Last year I used to go to school every day.*

Quand nous demeurions à la campagne, nous étudions toute la journée, — *When we lived in the country, we used to study all day.*

The imperfect tense of the four regular conjugations is summarised as follows :—

Je	chantais *was singing*	finissais *was finishing* rendais *was rendering*	recevais *was receiving*
Tu	parlais *wast speaking*	chérissais *wast cherishing* vendais *wast selling*	apercevais *wast perceiving*
Il	donnait *was giving*	fournissait *was furnishing* tendait *was tending*	percevait *was collecting*
nous	cherchions *were seeking*	punissions *were punishing* entendions *were hearing*	concevions *were conceiving*
vous	portiez *were carrying*	saisissiez *were seizing* perdiez *were losing*	deviez *were owing*
ils	aimaient *were loving*	unissaient *were uniting* mordaient *were biting*	décevaient *were deceiving*

The Past Definite.—The imperfect may be called the descriptive tense ; the past definite is the narrative and historical tense. It is used to express an action taking place at a definite time which has entirely elapsed before the time of speaking, as in—

Je parlai hier à votre frère, — *I spoke to your brother yesterday.*

Vous chantâtes bien l'année dernière, — *You sang well last year.*

Mon frère partit pour Paris, — *My brother left yesterday for Paris.*

In conversation the past definite would sound formal, and the past indefinite is usually preferred.

The following is a summary of this tense :—

je	chantai	finis	reçus	rendis
	sang	*finished*	*received*	*rendered.*
tu	parlas	chéris	aperçus	vendis
	spokest	*cherishedst*	*perceivedst*	*soldest.*
il	donna	fournit	perçut	tendit
	gave	*furnished*	*collected*	*tended.*
nous	cherchâmes	punîmes	conçûmes	entendîmes
	sought	*punished*	*conceived*	*heard.*
vous	portâtes	saisîtes	dûtes	perdîtes
	carried	*seized*	*owed*	*lost.*
ils	aimèrent	unirent	décurent	mordirent
	loved, liked	*united*	*deceived*	*bit.*

The Past Indefinite.—Expresses an action performed at a time only partly elapsed or entirely past but not specified, thus—

J'ai vu votre père jadis, — *I saw your father once.*

Je ne vous ai pas encore parlé, — *I have not yet spoken to you.*

The past indefinite may also be used when the time is expressed as comprehended in a specified period, as in—

Je lui ai écrit la semaine dernière, — *I wrote to him last week.*

Je lui ai envoyé une letter le mois dernier, — *I sent him a letter last month.*

This tense is composed of the present indicative of one of the auxiliaries **avoir** and **être**, and the past participle of a verb, thus—

J'ai parlé, *I spoke* or *have spoken.* — Je suis arrivé, *I arrived* or *have arrived.*

The Pluperfect.—The pluperfect is composed of the imperfect of the auxiliary, and the past participle of the leading verb, thus—

J'avais parlé, *I had spoken.* — J'étais venu, *I had come.*

This tense is used to express an action that took place before another past action, as in—

J'avais déjeuné quand il entra, — *I had breakfasted when he came in.*

Dès que j'avais fini ma tâche, je parlais à mon ami, — *As soon as I had finished my task, I used to speak to my friend.*

The Past Anterior.—The past anterior is formed by the past definite of the auxiliary and the past participle of the leading verb, thus—

J'eus parlé, *I had spoken.* — Je fus tombé, *I had fallen.*

This expresses an action that took place immediately before another past action, as in—

Dès que j'eus fini ma tâche, j'étais heureux, — *As soon as I had finished my task, I was happy.*

This tense is often preceded by **à peine,** *scarcely,* **dès que, aussitôt que,** *as soon as,* **quand, lorsque,** *when.*

The Future.—There are two forms of future, the future simple and the future anterior. The former simply shows that the action expressed will take place, as in—

La flotte partira, — *The fleet will sail.*

The following is a summary of the future tense in all four conjugations :—

je chanterai	finirai	recevrai	rendrai
shall or *will sing*	*finish*	*receive*	*render.*
tu parleras	chériras	apercevras	vendras
shalt or wilt speak	*cherish*	*perceive*	*sell.*
il donnera	fournira	percevra	tendra
shall or *will give*	*furnish*	*collect*	*tend.*
nous chercherons	punirons	concevrons	entendrons
shall or *will seek*	*punish*	*conceive*	*hear.*
vous porterez	saisirez	devrez	perdrez
shall or *will carry*	*seize*	*owe*	*lose.*
ils aimeront	uniront	décevront	mordront
shall or *will love*	*unite*	*deceive*	*bite.*

The Future Anterior.—The future anterior is composed of the future of one of the auxiliaries with the past participle of the leading verb, thus—

J'aurai fini, *I shall have done.* — Je serai tombé, *I shall have fallen.*

This tense expresses an action that will take place before another future action, as in—

Quand il sera venu, je le lui rendrai, — *When he has* (shall be) *come, I will give it back to him.*

Be careful to distinguish between the meaning of the English *will* used as an auxiliary, and its meaning as a leading verb. In the latter sense it must not be rendered into French by the simple future of the verb but by the present of **vouloir,** *to desire ;* thus—

Ne voulez-vous pas lui écrire ? — *Will you not* (do you not wish to) *write to him* ?

VOCABULARY

l'avocat (m.), *the barrister.*
le bruit, *the rumour, noise.*
ça (cela), *that.*
le cordonnier, *the shoemaker.*
dernièrement, *lately.*
le gant, *the glove.*
le ministre, *the minister.*
la clairière, *glade.*
la mitrailleuse, *machine gun.*
hargneux, *cross, surly.*
assister à, *to be present at, witness.*
la lutte, *the struggle, fight.*
le loup, *the wolf.*
le repaire, *the haunt, den.*
le musée, *the museum.*
le charpentier, *carpenter.*
le règne, *reign.*
le rédacteur, *editor.*
ôter, *to take off.*
le garçon, *the boy.*
le hameau, *the hamlet.*
faux, *false.*
loin de, *far from.*
la médecine, *medicine.*
mettre, *to put on,* mis, *put.*
passer, *to pass.*
le poirier, *the pear-tree.*

Exercise 27

1. Ce hameau n'est pas loin de la ville où vous avez été médecin. 2. Ces bruits, on les a crus faux. 3. Tout ça est passé. 4. Il nous a laissé un livre sur la médecine. 5. Auquel des deux dois-je donner cet argent ? 6. Ils l'auraient voulu voir de près. 7. Vous nous avez souvent parlé. 8. Je ne l'ai pas encore vu. 9. N'avez-vous rien dit à mon cousin ? 10. Je ne lui ai rien dit. 11. Qu'avez-vous fini aujourd'hui ? 12. Hier nous n'avons pas travaillé. 13. Lui en avez-vous souvent parlé ? 14. Je lui en ai souvent parlé. 15. Qui vous a dit cela ? 16. L'avocat me l'a dit. 17. L'avez-vous vu dernièrement ? 18. N'avez-vous pas ôté vos gants et vos souliers ? 19. Je n'ai pas ôté mes gants, mais j'ai ôté mon chapeau. 20. Ne lui avez-vous point dit que je suis ici ? 21. Je ne le lui ai pas encore dit.

Exercise 28

1. Your nephews spoke to us. 2. The shoemaker has taken his shoes off. 3. Have you told my cousin nothing ? 4. I have never met him. 5. I have often spoken to them about it. 6. Have you not written enough ? 7. Did you not work yesterday ? 8. We have read and worked all day. 9. Has not the tailor put his hat on ? 10. What did you say to that little boy ? 11. I have said nothing to him. 12. What have you studied this morning ? 13. We have studied our lessons and read our books. 14. Has the minister's gardener planted that pear-tree ? 15. Have you both a black cloth coat ? 16. We put on our shoes and stockings. 17. Had you not wanted me ? 18. Had you not intended to speak to me ? 19. As soon as you had finished your letter, did you not carry it to the post-office ? 20. As soon as you had arrived, did you not begin writing ?

Key to Exercise 25

1. He is afraid of committing a blunder. 2. Apparently that was sufficient. 3. Perhaps you will recognise her. 4. He does not recognise her. 5. That moment is well-known. 6. He perceives your intention. 7. We noticed our mistake. 8. Let him receive it in the heart. 9. I saw it at once. 10. You will receive it to-morrow. 11. We judged it correctly. 12. They bought meat, bread, and wine. 13. Accept, sir, our warmest thanks. 14. We prefer to go and die than to suffer dishonour. 15. She noticed her husband at the window. 16. Did the banker receive much money ?

Key to Exercise 26

1. Vos sœurs ont-elles écrit ? 2. Elles n'ont pas encore écrit. 3. Nous avez-vous apporté nos habits ? 4. Je n'en vends qu'une ; je garde l'autre pour ma belle-mère. 5. Recevez-vous de l'argent aujourd'hui ? 6. Nous n'en recevons guère. 7. Votre menuisier finit-il son travail de bonne heure ? Il le finit tard. 8. À quelle heure le finit-il ? 9. Il le finit à midi et demi. 10. Nous finissons le nôtre à dix heures moins vingt minutes. 11. Quand il vous a donné de l'argent hier, le remerciâtes-vous ? 12. Je le remerciai et je le priai de vous remercier. 13. Avez-vous trouvé vos livres ? 14. Je ne les ai pas encore trouvés. 15. Lorsque vous vîntes nous voir, ne finîtes-vous pas vos affaires avec mon père ?

E. A. B.

GERMAN.—XII

Relative Pronouns.—As has been stated, the demonstrative pronoun der, as well as the interrogatives wer, was, welcher, both in their pronominal and adjectival uses, are also used as relatives.

Der and welcher are interchangeable in the nom. and acc. cases, but in the dat. der is always preferable, and in the gen. deſſen and deren are always used.

Wer and was, together with was für and welcher, in their adjectival sense are, properly speaking, compound pronouns partaking of the nature of demonstratives and relatives, like English *what = that which*—wer zuletzt lacht, lacht am beſten, *he who laughs last laughs best;* tue was du nicht laſſen kannſt, *do what* (that which) *you cannot let alone;* ich zeigte ihm welche Armut hier ſei, *I showed him what poverty* (there) *was here;* wer weiß was für Geld er verloren hat? *who knows what money he has lost?*

Very often in German the demonstrative is repeated for the sake of greater clearness, even when we should omit it in English—Wer es nicht tun kann, der muß es laſſen, *he who cannot do it must let it alone.*

When the demonstrative is not in the nom. case it must always be repeated—Wer nicht ehrlich iſt, dem kann man nicht trauen, *he who is not honest cannot be trusted* (him one cannot trust).

The more indefinite forms *whoever, whatever,* can be rendered in German by inserting the word auch. In this case the conjunctive mood is used—Was er auch ſage, ich will ihn nicht ſehen, *whatever he may say I will not see him.*

After alles, etwas, nichts, manches, viel, wenig and the neuter personal and demonstrative pronouns, and also after an adjective used as a noun, especially if it be a superlative, the pronoun was is always used—Ich habe nichts geſehen was Sie intereſſieren würde, *I saw nothing that would interest you;* das iſt das beſte was Sie tun können, *that is the best that you can do.*

Instead of the dat. and acc. case when governed by a preposition, compounds of wo are used—Ich weiß nicht woraus das gemacht iſt, *I do not know what that is made of.*

Verbs with a relative as subject are always put in the third person, no matter what person the antecedent of the relative may be—Ich bin es der ruft, *it is I who am calling.*

The student should note carefully that the relative must always be expressed and can never be omitted even in the acc. case when it is frequently omitted in English—Hier iſt der Mann den ich geſtern ſah, *here is the man I saw yesterday.*

Indefinite Pronouns and Numerals.—We have already dealt with the indefinite pronouns man, jedermann, jemand, niemand, etwas and nichts. We may add here that was is often used for etwas, and that nouns used after etwas are in apposition to the pronoun—Ich nehme etwas Fleiſch, *I take some meat.*

Einig and etlich, both meaning *some,* are practically always used in the plural, and are declined like dies. They may be used as pronouns or adjectives.

Manch in the singular means *many a;* in the plural it means *many* or *a good many.* It is usually declined like dies, but before an adjective it is sometimes left uninflected; this is especially the case in verse—Manch ſchöne Spiele ſpiel' ich mit dir, *I will play many a fine game with thee.*

Viel, *much,* and wenig, *little,* are declined like ordinary adjectives when they follow any limiting word such as the articles and demonstratives, except ein wenig, *a little.* When not used adjectivally they may be followed by a partitive genitive—Viele der Kinder waren enttäuſcht, *many of the children were disappointed.*

The comparatives mehr, *more,* and weniger, *less,* are, as a rule, invariable, but mehr has a plural mehrere, meaning *several*—er hat mehr Bücher als ich, *he has more books than I;* but mehrere Kinder waren krank, *several children were ill.* This plural form can also be used with a partitive genitive after it—mehrere der Kinder, *several of the children.*

All, *all,* when it immediately precedes a noun, is declined like any other adjective, but when it is followed by the definite article or other pronominal word it may remain undeclined, especially if the meaning is distributive—aller Anfang iſt ſchwer, *all beginning is difficult;* alle deine Sachen ſind hier, *all your things are here;* all die Sachen ſind gekommen, *all the things have come.*

The plural of all is sometimes used distributively—alle Tage, *every day.* Ein, *one,* will be dealt with in the section on numerals. Kein is the negative of ein, as niemand is of jemand, and nichts is of etwas.

Idiomatic Uses of ſchon, *already*

Ich lebe hier ſchon ſeit drei Jahren, *I have been living here these three years.* Schon früher, *before this.* Schon lange, *for a long time*, or *a long time ago.* Er kommt ſchon, *he is coming* (don't worry). Ich werde es ſchon tun, *I shall be sure to do it.* Sie werden mich ſchon verſtehen, *you will understand me, I expect*, ſchon gut, *all right.* Er iſt gewiß ſchon fort, *he will certainly be gone by this time.* Schon der Gedanke macht ihn krank, *the very thought makes him ill.* Es wird mir ſchon gelingen, *I shall succeed yet.* Er mußte es ſchon tun, *he could not help doing it.* Darüber kann ich ſchon lachen, *I can well afford to laugh at that.* Hierauf verſagten ſeine ſchon von Natur ſchwachen Körperkräfte, *hereupon his naturally feeble bodily strength failed.* Ich kann es ſchon ſeinetwegen nicht tun, *I cannot do it if only on his account.* Das iſt ſchon der höchſte Grad von Undankbarkeit, *that is indeed the highest degree of ingratitude*, i.e. that is indeed in the highest degree ungrateful.

VOCABULARY

Entdeckung, w.f., *discovery.*
Amerika, *America.*
ungefähr, *about.*
Mitternacht, *midnight.*
von . . her, *from* (the direction of).
jauchzend, pres. part. of jauchzen, w., *to exult.*
erſchallen, w., *to resound.*
Schauder, s.m.1, *shudder.*
fahren, s.2*b*., *to run, dart.*
ſich überlaſſen, *to give oneself up to*, gov. dat.
Freude, w.f., *joy.*
Erwartung, w.f., *expectation.*
täuſchen, w., *to deceive.*
Zweifel, s.m.1, *doubt.*
unmöglich, *impossible.*
zwiſchen, *between.*
Hoffnung, w.f., *hope.*
Anbruch, s.m.2, *break.*
Auge (mixed), n., *eye.*
Erfüllung, w.f., *fulfilment.*
Wunſch, s.m.2, *wish.*
träge, *lazy, indolent.*
verſtreichen, w., *to pass.*
jeglich, *every.*
warten, w., *to wait.*
öſtlich, *eastern.*
ſchimmern, w., *to shimmer, gleam.*
lieblich, *sweet, lovely.*
anſtimmen, w., *to strike up.*
Mannſchaft, w.f., *crew.*
frohlockend, pres. part. of frohlocken, w., *to jubilate.*
Gott, s.m.3, *God.*
Volk, s.n.3, *people.*
gleichfalls, *in like manner.*
rührend, pres. part. of rühren, w., *to touch.*
denn, *for.*
wünſchen, w., *to wish.*
liegen, s.1*d*, *to lie.*
vor, *before.*
voraus, *on ahead.*
Freudengeſchrei, *shout of joy.*
Land, s.n.3, *land.*
freudig, *glad, joyous.*
dabei, *at this.*
Schiffsvolk, s.n.3, *ship's company.*
gleich, *at once.*
aus'ſchweifend, pres. part. of aus'ſchweifen, w., *to launch out hence unrestrained.*
ängſtlich, *anxious, fearful.*
ſich miſchen in, *to mingle with* (w.).
unterdrücken, w. *to crush, subdue.*
Furcht, w.f., *fear.*
erwarten, w., *to await.*
eigen, *own.*
überzeugen, w., *to convince.*
ſehnlich, *ardent, passionate.*
Traum, s.m.2, *dream.*
übrig, *remaining.*
ſchlaflos, *sleepless.*
vorübergehen, s., *to pass by.*
Stunde, w.f., *hour.*
ſcheinen, s.3*b*, *to seem.*
hoffen, w., *to hope.*
Himmel, s.m.1, *sky.*
hervortreten, s.2*a*, *to appear.*
Morgenröte, *flush of dawn.*
auf einmal, *suddenly.*
laut, *loud.*
Stimme, w.f., *voice.*
Herr, w.m., *master, lord.*
loben, w., *to praise.*
beide, *both.*
allgemein, *general.*
Loblied, s.n.3, *song of praise.*
gegen, *towards.*
Pinta, *Pinta* (the name of a ship).
ertönen, w., *to sound.*
entdecken, w., *to discover.*
nunmehr, *now.*

Exercise 31

Entdeckung Amerikas

Ungefähr gegen zwei Uhr nach Mitternacht hörte[1] man von der Pinta her[2], welche immer voraus war, das jauchzende Freudengeſchrei[3]: Land! Land! erſchallen[4], und ein freudiger Schauder fuhr allen[5] dabei durchs Herz. Wie gern hätte[6] das Schiffsvolk ſich nun gleich der ausſchweifendſten Freude überlaſſen; aber es[7] war ſo oft ſchon in ſeiner[7] Erwartung getäuſcht worden, daß es die ängſtlichen Zweifel, die ſich in ſeine Freude miſchten, unmöglich[8] unterdrücken konnte. Zwiſchen Furcht und Hoffnung erwartete man alſo den Anbruch des Tages, um ſich mit eignen Augen zu überzeugen daß die Erfüllung ihres ſehnlichſten Wunſches kein Traum geweſen ſei.[9]

Träge wie ſie dem ſchlafloſen Kranken verſtreichen, gingen ihnen die noch übrigen Stunden der Nacht vorüber. Jegliche[10] Minute ſchien ihnen eine Stunde, jegliche Stunde ein ganzer langer Tag zu ſein. Endlich, nach langem Warten und Hoffen, fing der öſtliche Himmel an ein wenig zu ſchimmern. Jetzt trat die liebliche Morgenröte hervor. . . . Auch das Volk der beiden übrigen Schiffe . . . . . ließ ſeine Stimme zu einem allgemeinen rührenden Loblied ertönen. Denn das Land welches zu entdecken ſie ſo ſehnlich gewünſcht hatten, lag nunmehr vor ihren Augen da.

Campe.

NOTES:—

(1) hörte man, here best translated by the passive voice. The student must use his discretion as to when to translate man by *one, you*, or *they*, and when to turn the sentence into the passive voice. (2) her, as usual, denotes motion towards the speaker or the persons referred to. (3) Freudengeſchrei, a compound of the w.f. Freude, *joy*, and the s.n. Geſchrei, *shouting, cry.* (4) erſchallen, —the infinitive depends on hörte. (5) allen, a so-called dative of interest; literally, *ran for all through the heart:* the def. art. is used instead of the poss. pron. as the person is represented by a pron. in the dat. (6) hätte ſich überlaſſen—past conjunctive, *would have given itself up.* (7) es refers to Schiffsvolk, as does ſeiner. (8) unmöglich adjective, used as an adverb; best rendered in English by such a phrase as *it was impossible.* (9) ſei, the conjunctive is used in noun clauses that depend on a verb expressing perception; it is regarded as a kind of indirect statement. (10) jeglicher, an older form of jeder.

VOCABULARY

greatness, Größe, w.f.
of, von.
conquer, beſiegen, w.
take prisoner, gefangen nehmen, s.1*c*.
number, Zahl, w.f.
other, ander.
according to, nach.
war, Krieg, s.n.2.
to make, um . . . . zu machen.
bad, ſchlecht.
victory, Sieg, s.m.2.
therefore, alſo.
show, erweiſen, s.3*b*, gov. dat. of pers.
same, ſelb.
respect, Rückſicht, w.f.
if, ob.
deserve, verdienen, w.
alone, allein.
reign, regieren, w.
observe, merken, w.
compel, zwingen, s.1*a*.
enemy, Feind, s.m.2.
bestow, ſpenden, w.

as, als.
treat, behandeln, w.
soul, Seele, w.f.
Macedonia, Macedonien.
Persia, Perſien.
infinite, unendlich.
among, unter, gov. dat.
wife, Frau, w.f.
law, Geſetz, s.n.2.
make slaves of, zu Sklaven machen, w., gov. acc.
use, Gebrauch, s.m.2.
attention, Aufmerkſamkeit, w.f.
beautiful, ſchön.
subject, Unterthan, w.m.
victorious, ſiegreich.
worthy, würdig.
stead, Stelle, w.f.
by, an.
virtue, Tugend, w.f.
even, ſelbſt.
praise, Lob, s.n.

Exercise 32

GREATNESS OF SOUL (1)

Alexander the Great, king of Macedonia, having conquered (2) Darius, king of Persia, took an infinite number (3) of prisoners, and among others, the wife and mother of Darius. Now, (4) according to the laws of war, (5) he might have made (6) slaves of them; but he had too much greatness of soul to make (7) a bad use of his victory; he therefore treated them as queens, and showed them the same attentions (8) and (the same) respect as if (9) he had been their subject; which (10) Darius hearing, said that Alexander deserved (11) to be victorious, and that he alone was (11) worthy to reign in his stead. Observe by this how virtue and greatness of soul compel (12) even enemies to bestow praise.

Lord Chesterfield: Letters to his son.

NOTES:—

(1) Make one word of *greatness of soul*, i.e. Seelengröße. (2) Translate *when he had conquered*. (3) Supply *of people* (Menſchen) after number. (4) Omit *now*. (5) *Laws of war*; compound word Kriegsgeſetze. (6) Might have made hätte . . . machen können. (7) *To make*, um . . . zu machen. (8) Use *attention* in the singular. (9) *If he had been*, ob er . . . geweſen wäre (conjunctive). (10) Translate *when Darius heard this, he said*. (11) Use present conjunctive. (12) Translate *compel even enemies thereto* (dazu) *praise to bestow*.

Key to Exercise 29

THE CASTLE BY THE SEA

Hast thou seen the castle, the lofty castle by the sea? Golden and rosy clouds are wafted (blow) over it. It would fain bow down into the waters clear as a mirror; it would fain aspire and mount upwards into the glow of the evening clouds. I have indeed seen it, the lofty castle by the sea, and the moon standing above it and mist far around. The wind and flow of the sea, did they sound joyous (emit a fresh sound)? Didst thou hear from out of the halls music (strings) and festal songs?

Key to Exercise 30

Der Kaiſer Joſeph der Zweite kam einmal vor ſeinem Gefolge in einer Stadt an, und ſeine Wirtin die ihn nicht kannte fragte ihn ob er einer der Diener des Kaiſers ſei. „Nein" antwortete der Fürſt. Aber die Neugier der guten Frau wurde durch dieſe kurze Antwort nicht befriedigt, und ſie benutzte eine Ausrede um in ihres Gaſtes Zimmer zu gehen. Er raſierte ſich gerade als ſie ins Zimmer kam, und ſie fragte ihn ob er nicht dem Kaiſer auf irgend welche Weiſe diente. „Ja", ſagte Joſeph, „ich raſiere ihn manchmal."

M. A. L.

RUSSIAN.—V

The Noun

The Instrumental Singular

25. THE following are the endings of this case:

Masculine: -омъ, -емъ, -емъ, instead of ъ, й, ь, in Nominative, respectively.

Feminine: -ой, -ей, -ью, instead of а, я, ь, in Nominative, respectively.

Neuter: омъ, -емъ, instead of о, е, in Nominative, respectively. (See Rule 1.)

Examples:

Фабрика́нтомъ	*with* (= by) *the manufacturer.*
Това́ромъ	*with the goods.*
Казначе́емъ	*with the treasurer.*
Сара́емъ	*with the stable.*
Покупа́телемъ	*with the customer.*
Ве́кселемъ	*with the bill.*
Фи́рмой	*with the firm.*
Торго́влей	*with the business.*
При́былью	*with the profit.*
Сло́вомъ	*with the word.*
По́лемъ	*with the field.*

NOTE.—Instead of -ой, -ей, some give to Instrumental Feminine the endings of -ою, -ею, but the latter are not used extensively.

Influence of the Hissing Letters

26. If the ъ of Nominative Masculine or the а of the Nominative Feminine are preceded by any of the missing letters, such as ж, ч, ш, щ, the Instrumental endings -омъ, -ой, or -ою then change into -емъ, -ей, or -ею. Feminine nouns with ending of -ца in Nominative have likewise the ending -ей, or ею, in the Instrumental.

Examples:

Nominative:		*Instrumental:*
Сто́рожъ	*the caretaker*	Сто́рожемъ
Сургу́чъ	*sealing wax*	Сургу́чёмъ
Кла́вишъ (кла́виша)	*the key of a piano*	Кла́вишемъ (Кла́вишей)
Прыщъ	*a pimple*	Прыщемъ
Ко́жа	*leather*	Ко́жей
Да́ча	*a country house*	Да́чей
Ча́ша	*a bowl*	Ча́шей
Пи́ща	*food*	Пи́щей
Пти́ца	*a bird, fowl*	Пти́цей

Uses of the Instrumental Case

27. It is used, without a preposition, to denote the following:

(*a*) The means or agency by which something is effected, often expressed in English by *with* (not meaning *along with*).

Examples:

Писа́ть перо́мъ	*to write with a pen.*
Вы́звать телегра́ммой	*to call out* (or summon) *by telegram.*
Ѣхать мо́ремъ	*to travel by sea.*

(*b*) The authority by which something becomes legalised.

Examples :

Дозво́лено цензу́рою	*passed by* (the office of) *the censor.*
Утверждено́ Прави́тельствомъ	*ratified by the Government.*
Засвидѣ́тельствовано Нота́ріусомъ	*testified by the notary.*

(*c*) The seasons of the year and the periods of the day, viz. :

Зимо́ю	*in winter.*
Лѣ́томъ	*in summer time.*
Весно́ю	*in the spring.*
О́сенью	*in autumn.*
Днёмъ	*by day.*
Но́чью	*by night.*
У́тромъ	*in the morning.*
Ве́черомъ	*in the evening.*

Verbs governing the Instrumental Case

28. The following verbs require the Instrumental after them (without preposition) :

Торгова́ть	*to deal in . . .*
Занима́ться	*to practise, to busy oneself with . .*
Интересова́ться	*to be interested, to interest oneself in . . .*
Забавля́ться	*to amuse oneself with . . .*
Отлича́ться	*to excel oneself in . . .*
Сла́виться	*to be famous by or through . .*
Горди́ться	*to take pride in . . .*
Счита́ться	*to be reputed, regarded as . . .*
Ра́зниться	*to differ . . .*
Называ́ться	*to go by the name of . . .*
По́льзоваться	*to profit by . . . To avail oneself of . . .*
Злоупотребля́ть	*to abuse . . .*

Prepositions governing the Instrumental

29. The Instrumental Case is used after the following prepositions :

(*a*) За, *behind ;* Пе́редъ, or :— предъ *before ;* Подъ, *under,* and Ме́жду, *between ;* — when they point to the place, where something is definitely situated or acting (not moving towards). They all answer the question: Where ?

(*b*) Надъ, *over, above ;*

Съ, *with* (= along with, together with).

Practice XIV

Change into Instrumental the following Nominatives :

Челове́къ,	*a man.*	Продажа,	*sale.*
Геро́й,	*a hero.*	Честь,	*honour.*
Звѣрь,	*a wild beast.*	Ку́рица,	*a hen.*
Куртажъ,	*brokerage.*	Ку́ча,	*a heap, pile.*
Кала́чъ,	*calatch* (a kind of small Russian white-bread loaf).	Но́ша,	*a load, burden, cargo.*
Шала́шъ,	*a hut.*	Ча́ща,	*a dense wood, thicket.*
Плащъ,	*a cloak, mantle.*	Зе́ркало,	*a mirror.*
Бума́га,	*paper.*	Го́ре,	*trouble.*
Ку́пля,	*purchase.*	Бѣлье́,	*linen, underclothing, bedlinen.*

The Verb

Influence of the Laws of Permutation on the 1st Conjugation

30. Some Verbs ending with -жать, -чать, -шать, and -щать are conjugated according to the 2nd Conjugation, i.e. by having in the 2nd Singular -ишь at the end, and in the 3rd Plural -ать, as exemplified below :

Infinitive : Держа́ть, *to hold, keep*

Я держу́	*I hold.*	Мы де́ржимъ	*we hold.*
Ты де́ржишь	*thou holdest.*	Вы де́ржите	*you hold.*
Онъ де́ржитъ	*he holds.*	Они де́ржатъ	(m.), *they hold.*
Она́ де́ржитъ	*she holds.*	Онѣ де́ржатъ	(f.), *they hold.*
Оно́ де́ржитъ	*it holds.*	Они де́ржатъ	(n.), *they hold.*

31. The principal verbs conjugated according to Rule 30 are as follows :

Лежа́ть	*to lie, be situated, to rest.*
Крича́ть	*to cry, shout.*
Торча́ть	*to protrude, be salient.*
Молча́ть	*to be silent, reticent.*
Слы́шать	*to hear, from a distance.*
Пища́ть	*to squeak.*

32. The majority, however, of verbs ending with -жать, -чать, -шать, and -щать follow the 1st Conjugation in accordance with Rule 6.

Examples :

Погружа́ть	*to sink.*
Угрожа́ть	*to threaten.*
Поража́ть	*to astonish, defeat, strike.*
Конча́ть	*to finish.*
Отвѣча́ть,	*to answer.*
Вѣнча́ть	*to crown.*
Слу́шать	*to hear attentively, obey.*
Вкуша́ть	*to enjoy, relish.*
Ощуща́ть	*to feel.*
Смуща́ть	*to trouble, disconcert, confuse.*

33. Some verbs ending with -дѣть follow the 2nd Conjugation as per Rule 23, the first Singular ending in -жу, while others follow Rule 6 with no change. Thus : ви́дѣть, *to see ;* гляде́ть, *to look ;* сиде́ть, *to sit,* are conjugated :

Sing.

Я ви́жу, гляжу́	*I see, look.*
Ты ви́дишь, гляди́шь	*thou seest, lookest.*
Онъ ви́дитъ, гляди́тъ	*he sees, looks.*
Она́ ви́дитъ, гляди́тъ	*she sees, looks.*
Оно́ ви́дитъ, гляди́тъ	*it sees, looks.*

Plur.

Мы ви́димъ, глядимъ	*we see, look.*
Вы ви́дите, глядите	*you see, look.*
Они́ ви́дятъ, глядятъ	*they* (m.) *see, look.*
Онѣ ви́дятъ, глядятъ	*they* (f.) *see, look.*
Они́ ви́дятъ, глядятъ	*they* (n.) *see, look.*

But the verbs—

Владѣть,	*to possess* (always with Instrumental Case).
Худѣть,	*to become lean, worse.*
Рѣдѣть,	*to diminish, grow scarce.*

are conjugated like the verbs in Rule 6.

34. The verb смотрѣть, *to look at, to look* or *appear like* (with Instrumental), is conjugated as follows :

Я смотрю́ ; ты смо́тришь ; онъ, она́, оно́ смо́тритъ ; мы смо́тримъ ; вы смо́трите ; они́, онѣ, они́ смо́трятъ.

35. The verb терпѣть, *to have patience, to suffer, tolerate,* is conjugated as follows :

Я терплю́ ; ты те́рпишь ; онъ, она́, оно́ те́рпитъ ; мы те́рпимъ; вы те́рпите ; они́, онѣ они́ те́рпятъ.

36. Some verbs ending with -зать, -кать, -сать, -скать, -стать, -тать and -хать, are conjugated as if they originally ended in -жать, -чать, -шать, -щать -чать and -шать. The **а** is thrown out throughout the whole conjugation of the present tense, and the **ю** of the 1st Singular and of the 3rd Plural is replaced by **у**. See the following table :

Запа́съ	(za-pás), *stock.*
Отка́зъ	(at-kás), *refusal, discharge.*
До́лжность	(dól-zhnost), *duty, post.*
То	(to), *that.*
Зда́ніе	(zdá-ni-ye), *building.*
Флагъ	(flag), *flag.*
Купо́лъ	(ku-pól), *cupola, dome.*
Флотъ	(flot), *fleet.*
Хра́брость	(khráb-rost'), *bravery.*
Жа́лоба	(zhá-lo-ba), *complaint.*
Ма́льчикъ	(màl-chik), *boy.*
Страхъ	(strakh), *fear.*
Рисова́ть	(ri-sa-vát), *to draw.*
Каранда́шъ	(ka-ran-dásh), *pencil.*
Скамья́	(ska-myá), *bench, form.*
Бага́жъ	(ba-gázh), *luggage.*
Спо́рить	(spó-rit), *to dispute.*
Зерно́	(zyer-nó), *grain, corn.*
Конкурри́ровать	(kon-ku-ri-ro-vat), *to compete.*
Имѣніе	(i-myé-ni-ye), *estate.*
Капита́лъ.	(ka-pi-tál), *capital.*

Exercise 7

Translate the following into English :

1. Я запеча́тываю письмо́ сургучёмъ. 2. Хозя́инъ дово́ленъ сто́рожемъ. 3. Мы вызыва́емъ вояжёра телегра́ммой. 4. Я рабо́таю бо́льше зимо́ю, чѣмъ лѣтомъ. 5. Я конча́ю рабо́ту ве́черомъ. 6. Мы торгу́емъ муко́й. 7. Я интересу́юсь дѣломъ. 8. Ру́сскій отлича́ется хра́брostью. 9. Я держу́ большо́й запа́съ са́хару. 10. Господи́нъ Б. счита́ется богачёмъ. 11. Что Вы слы́шите отъ вояжёра ? 12. Онъ намъ пи́шетъ о́чень ча́сто. 13. Хозя́инъ угрожа́етъ прика́щику отка́зомъ отъ до́лжности. 14. Ви́дите ли Вы то зда́ніе ? 15. Да, я ви́жу. 16. Что означа́етъ флагъ надъ его́ купо́ломъ ? 17. Онъ означа́етъ, что Англія владѣетъ мо́ремъ. 18. Какъ она́ владѣетъ ? 19. Фло́томъ.

37. *Table A.—First Conjugation with Permutables* :

	1st Group -зать	2nd Group -кать	3rd Group -сать	4th Group -скать	5th Group -стать	6th Group -тать	7th Group
Infinitive English	Рѣзать *to cut, engrave*	Пла́кать *to cry, weep*	Писа́ть *to write, paint*	Иска́ть *to seek, look for*	Свиста́ть *to whistle*	Пря́тать *to hide, conceal*	Махать *to wave, brandish*
Я	рѣ́жу	пла́чу	пишу́	и́щу	свищу́	пря́чу	ма́щу,
Ты	рѣ́жешь	пла́чешь	пи́шешь	и́щешь	сви́щешь	пря́чешь	ма́шешь
Онъ, она́, оно́	рѣ́жетъ	пла́четъ	пи́шетъ	и́щетъ	сви́щетъ	пря́четъ	ма́шетъ
Мы	рѣ́жемъ	пла́чемъ	пи́шемъ	и́щемъ	сви́щемъ	пря́чемъ	ма́шемъ
Вы	рѣ́жете	пла́чете	пи́шете	и́щете	сви́щете	пря́чете	ма́шете
Они́, онѣ, они́	рѣ́жутъ	плачутъ	пишутъ	и́щу́тъ	сви́щутъ	пря́чутъ	ма́шутъ

Practice XV

Conjugate the following :

(*a*) As rule 30 —Молчать, *to keep silent.*
(*b*) As rule 37, group 1—Вязáть, *to bind, knit.*
(*c*) As rule 37, group 2—Рыкáть, *to roar, bellow.*
(*d*) As rule 37, group 3—Плясáть *to dance.*
(*e*) As rule 37, group 4—Плескáть, *to splash.*
(*f*) As rule 37, group 6—Хохотáть, *to laugh, giggle.*
(*g*) As rule 37, group 7—Пахáть, *to plough, till.*
(*h*) As rule 6 —Ползáть, *to creep, crawl.*
Бросáть, *to throw, leave off, forsake.*

VOCABULARY

Запечáтывать	(za-pe-chá-tu-vat),	*to seal.*
Довóленъ	(da-vó-lyen),	*is satisfied.*
Вызывáть	(vü-zü-vát),	*to summon.*
Мукá	(mu-ká),	*flour.*
Богáчъ	(ba-gách),	*a wealthy man.*

Exercise 8

Translate the following into Russian :

1. I very seldom hear a complaint from a customer. 2. The boy feels fear of (предъ) the master. 3. The packer shouts very much. 4. I am looking how you draw with a pencil. 5. Where do you keep the traveller's luggage ? 6. Under the bench. 7. He looks a wealthy man. 8. I write home very often. 9. What (чего́) are you looking for ? 10. I am looking for a pencil. 11. I do not like you to (Translate : I do not like that you) dispute with the customer. 12. The question confuses the firm. 13. I am not interested in the order, for I do not see any profit. 14. We deal in corn. 15. I possess an estate. 16. He possesses no capital. 17. We compete with (= by) the quality of the goods.

A. C.

Continued from page 359.

GEOGRAPHY:

Contributors:—Robert Finch, F.R.G.S.; W. H. Koebel; Sir John Scott-Keltie, LL.D.; Cyril J. Silverston, B.Sc.(Lond.).

MAN AND HIS WORK

MAN, in virtue of his faculty of speech, is assumed to be the highest member of the animal kingdom. Of his descent and antiquity we will not speak here; the student will find these matters fully dealt with in the lessons in *Ethnology* and *Anthropology*.

In modern times, five broad groups of mankind are distinguished, viz., the Negro, the Mongolian, the Amerindian, the Australoid, and the Caucasian.

The Negro group is distinguished by short, jet-black, woolly hair, a very dark brown or blackish skin, and a protruding jaw (prognathous). The nose is flat, small, and broad at the base; the eyes are large, round, and prominent; and the stature is rather above the average of the human race. In temperament the negro is indolent, sensuous, fitful and uncertain. Speaking generally, there are two main types of the negro group: the African or western, and the Oceanic or eastern.

Five Races of Mankind

The Mongolian group has coarse, lank hair of a dull black shade, a yellowish or brown skin, and a jaw not projecting so much as that of the negro. The nose is small and snub, but is inclined to be variable; the eyes are small and obliquely set; and stature is under the average. In temperament the Mongolian people are sluggish, and have generally but little initiative, possess great powers of endurance, and are usually frugal and thrifty, but their moral standard is low. In distribution they include the Mongols of Central Asia and Siberia, the Turks and Tatars, Amerindians of America, also such European varieties as Magyars and Bulgars, and the Japanese. The Eskimos also belong to this group. A southern type is represented by the inhabitants of Tibet, Indo-China, and the Chinese proper. In this group also are Oceanic types found in the Malay Peninsula, Madagascar, etc.

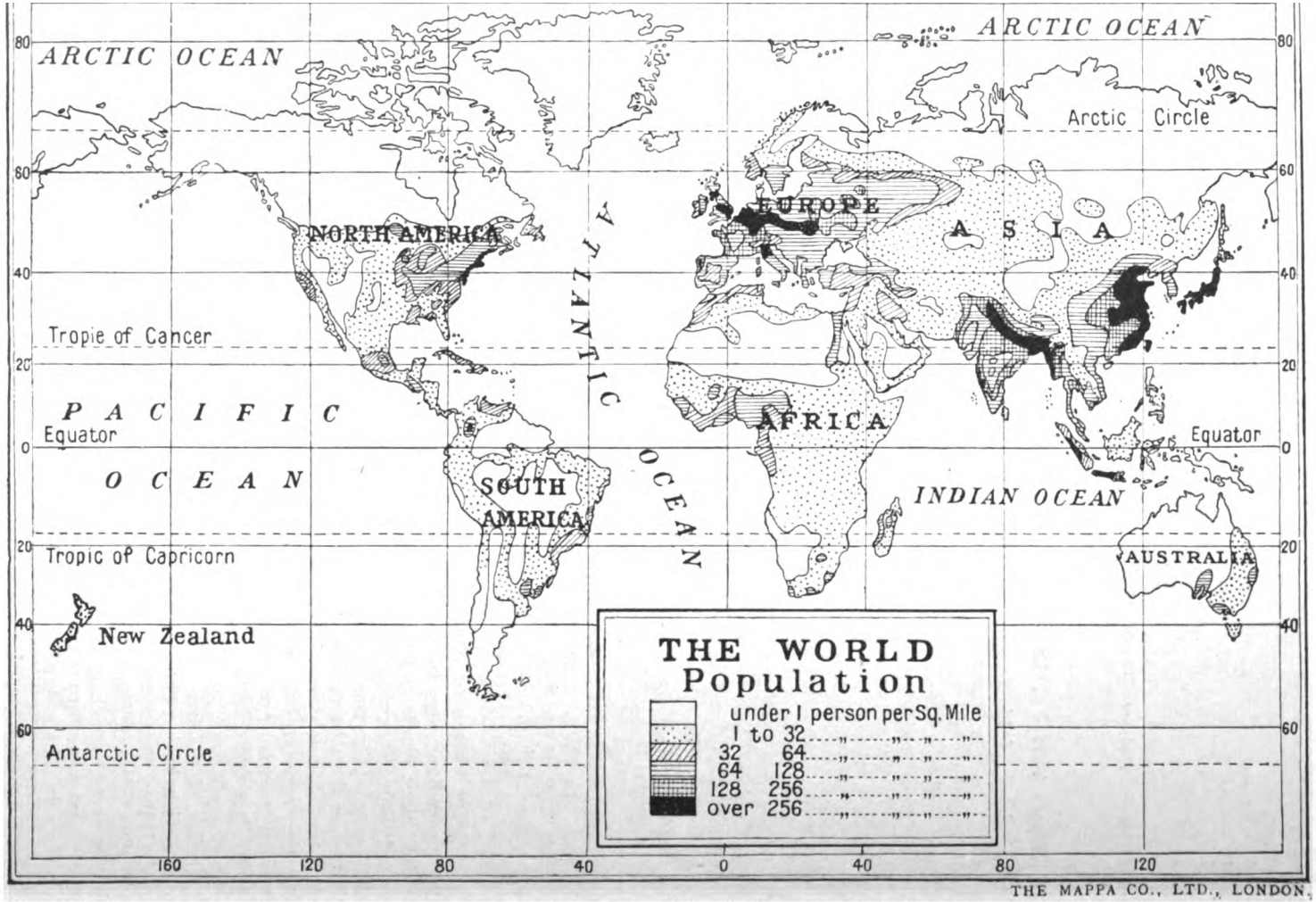
The Amerindian group has very coarse black and long hair; brown coppery and yellowish skin; large, arched and narrow nose; and small, round, black, rather sunken eyes. In height Amerindians are about the average and over. Their temperament is taciturn, impassive in the presence of strangers. The group includes the North-American Indian, the Mexican (Aztec) type, and the Indians of South America of various types. The Australoid, now confined almost wholly to the Australian continent, is the lowest existing human type. The Caucasian or white man is the highest.

Mankind, although dependent for its food upon vegetation (for, even if that food is in part animal, the plant world provides the animal with its sustenance), is yet, at any rate among civilised peoples, able to live at almost any distance from its source of supply owing to the perfection to which he has brought methods of transport and communication. And further, being able to procure material for dwellings, clothing, etc., he is able to live in climates and under conditions which would be impossible for any creature not protected as he is able to be. Thus we find that, of the two great natural agencies by which climate is affected, that of temperature has in itself comparatively little influence in determining the density of the population of any region.

Population and Rainfall

Rainfall, on the contrary, is of far greater importance, as a supply of water is much more difficult to procure from distant sources, and is as necessary as food to the human race. In parts of India, for instance, it has been pointed out that the population per square mile varies with the mean amount of rainfall.

Population is naturally scanty in desert regions and in the polar zones. The dense forests of the world, such as are found in South America, contain no large centres of population, being inhabited at most by wandering tribes in comparatively small numbers. In such regions it is the fringes of the desert or forest that are the more



THE MAPPA CO., LTD., LONDON.

Mankind has a marked tendency to congregate at or near the mouths of great rivers, e.g. the Ganges, Yang-tse-kiang, Rhine, and even the St. Lawrence. Other factors which influence populations are rainfall, temperature, and the natural (minerals, etc.) resources of the land.

thickly inhabited. The configuration of the land exercises a more direct influence on the density of population. In hot regions, for example, the higher lands will be more densely inhabited owing to the greater comfort obtained at high altitudes. In colder regions the lowlands, being warmer, will support more inhabitants.

Another cause contributing to the massing of population in certain regions is the tendency of mankind to congregate at or near the mouths of the great rivers. This is especially noticeable in a population map of the world, where we perceive that the alluvial plains or deltas of the Nile, Ganges, Yang-tse-kiang, and Hoang-Ho, the Rhine, Thames, and even the St. Lawrence in North America are much more thickly populated than the adjacent regions.

Naturally enough, too, population tends to centre in those districts where some natural source of one or other of the necessaries or conveniences of life is to be found. This is especially the case where there are minerals. In the British Isles, for example (with the exception of the London district), the densest centres of population accurately correspond to the coal and iron deposits.

Where Men Congregate

In the early stages of the development of mankind two conditions were essential for permanent aggregations of population: the first a supply of water, the second a suitable locality for growing food. Thus we find that the early primitive towns were established on a fertile plain near to a river or spring. Whether this settlement was to grow to a town of any considerable size depended upon other considerations. Let us take an example which will be familiar to all of us—the Thames Valley. All along this valley there was a string of settlements, any one of which possessed the two qualifications mentioned above.

As civilisation progressed it was found advantageous to establish centres of population at any place where it was convenient to load and unload ships, and we thus find that at such places have been established the chief ports. It is almost unnecessary to mention any of these, but as examples we may call to mind Antwerp, Lisbon, Bombay, Sydney, and New York. That region near a river mouth as far up the stream as it is possible for sea-going ships to be navigated is especially chosen, and, taking the Thames Valley again, we see that London is fixed upon as the upper limit of navigation of the Thames. A place where a bridge can more easily be thrown across the river is again specially favoured, and once more we find that at London and no lower down the river could the Thames easily be spanned.

Another essential condition if the town is to grow to any considerable size is the ease with which communication can be maintained with other parts of the country; thus we should expect a position where several valleys converge — other circumstances being favourable—to be selected as a site for a town. Examples of such positions in the Thames Valley are Reading and Oxford. Paris is the centre or meeting-place of many valleys communicating with Holland, Belgium, Switzerland, Germany, and Italy, and with the south-east of France; Lyons is the meeting-place of the Rhone and Saône valleys; and other examples can easily be multiplied if the map of the world is studied.

Industrial Considerations

One additional advantage has London: it occupies a position on a navigable river which faces a very important river on the continent of Europe — the Scheldt. The estuary of this river, besides itself being a centre of a great commercial population, opens a pathway into the heart of a most populous region through which a large amount of trade is done with the Continent.

But many of our great towns and cities have not all these advantages; they have grown up owing their importance to other considerations of, locally, even greater force. The great Lancashire cotton-spinning towns, for instance, have arisen there as being near a port which will serve to unload the vessels bringing the raw cotton from America, near sources of coal which are necessary to the manufacture of cotton goods from the raw material, and in that moist atmosphere which is essential for cotton-spinning.

Other industries have been established in districts owing to various natural advantages, or to the fact that the natural source is there situated. Obvious examples are the connection between Johannesburg and gold-mining in the Transvaal, Kimberley, and diamond-mining in Cape Colony. Towns, again, have been established at or near some great source of power such as the Niagara Falls, and also at places of strategic importance such as Constantinople or Gibraltar.

Many if not most of the industries of the world have their basis in geographical considerations. Either the products—vegetable, animal, or mineral—with which they are connected occur in certain regions and not

in others; or the process of manufacture, if not conducted on the spot where these products are obtained, depends upon some other geographical consideration.

Hunting obviously depends for its nature upon the character of the fauna of the country. The non-domesticated animals which are hunted for the sake of their furs are mostly mammals, and those found in cold climates having the densest coats are the most highly prized. The African elephant is hunted for ivory, though nowadays, at least in British territories, under restrictions, as the great number that used to be killed seriously threatened the extinction of the species. The ivory of the Indian elephant is comparatively valueless from the commercial point of view.

Fishing and Forestry

The Fishing industry is carried on as a means of providing food, other uses of fish being comparatively unimportant. Broadly speaking, fish are caught either on a line or in a net. In the former way are caught haddock, plaice, whiting, cod, halibut, skate, etc., and fish caught with a line command a better price in the market than trawled fish, as they are generally less bruised and injured, and are landed fresher. By means of nets are caught herrings, mackerel, pilchards, etc. The great majority of the fish caught round the British Isles are trawled, and in this way are obtained soles, turbot, brill, as well as haddock, cod, whiting, etc.

The areas chiefly frequented by fishermen are the North Sea, and generally the seas round the British Isles, the "Banks" of Newfoundland, and the coasts of Canada. It is interesting to note that all the great fishing areas are situated on the "continental shelf," there being practically no fish caught in the deep oceanic areas. In Russia the fisheries of the inland Caspian and Aral seas are important, and in the Volga many thousands are employed in the sturgeon fishery, which fish yields caviare, made from the roe, and isinglass. The great lakes of North America also employ many people in their fisheries.

Forestry is, in Great Britain, a very much neglected industry.

On the continent of Europe large areas of land, ranging from as much as 35 per cent. in Bosnia and Herzegovina to about 20 per cent. in some of the other countries, are under forest, and Russia, Sweden and Norway are large exporters of timber. From these countries are obtained the fir and pine woods known commercially as deal. Other great timber-producing regions are Canada (where the forests are estimated at nearly 45 per cent. of the total area of the country) and the United States of America.

Agriculture is carried on all over the world where the climate permits, and depends entirely upon the nature of the vegetable products of the country.

Ranching, which is the industry connected with the keeping, breeding and rearing of sheep or cattle, generally on large unenclosed areas, is chiefly followed in North America, in the United States west of the Mississippi such as Texas, Kansas, Arizona, Wyoming, etc. In South America a corresponding industry flourishes in Argentina and Uruguay, and although the name is not used for the Australian sheep stations, the industry is essentially similar. In Canada a ranch may be either a stock farm or the term may even be used for the fruit farms of sometimes comparatively small area which have been established in fairly recent years.

Dairy-farming consists in the management of farms with special reference to dairy products such as milk, both natural and condensed, and the cheeses, especially of the soft varieties. Large dairies are naturally situated in the grass-growing regions, and hence we find them in England principally in Cheshire, West Yorkshire, Leicestershire, Gloucestershire, Somerset, and Wiltshire.

Dairy-farming

Other countries in which dairy-farming is extensively followed are Denmark (where the proportion of milch cows is as high as 43 per 100 of the population, and which is consequently one of the most important dairy-farming centres), Finland, Sweden and Norway, and Holland. Canada, Australia, and the United States of America have also important dairy-farming districts.

Condensed milk is largely manufactured in Switzerland and other countries by evaporating whole milk under reduced pressure.

Fruit Growing is a very speculative industry, but is followed on a very extensive scale, much being canned besides that exported either fresh or in refrigerating chambers. Apples are grown for export in Canada, Australia, and Tasmania. Grapes are imported from the Continent, Algiers, California, etc. Oranges are grown in Spain, the Mediterranean countries generally, and Florida. From Jamaica and the Canary Islands come bananas, and pineapples from the Azores and Florida.

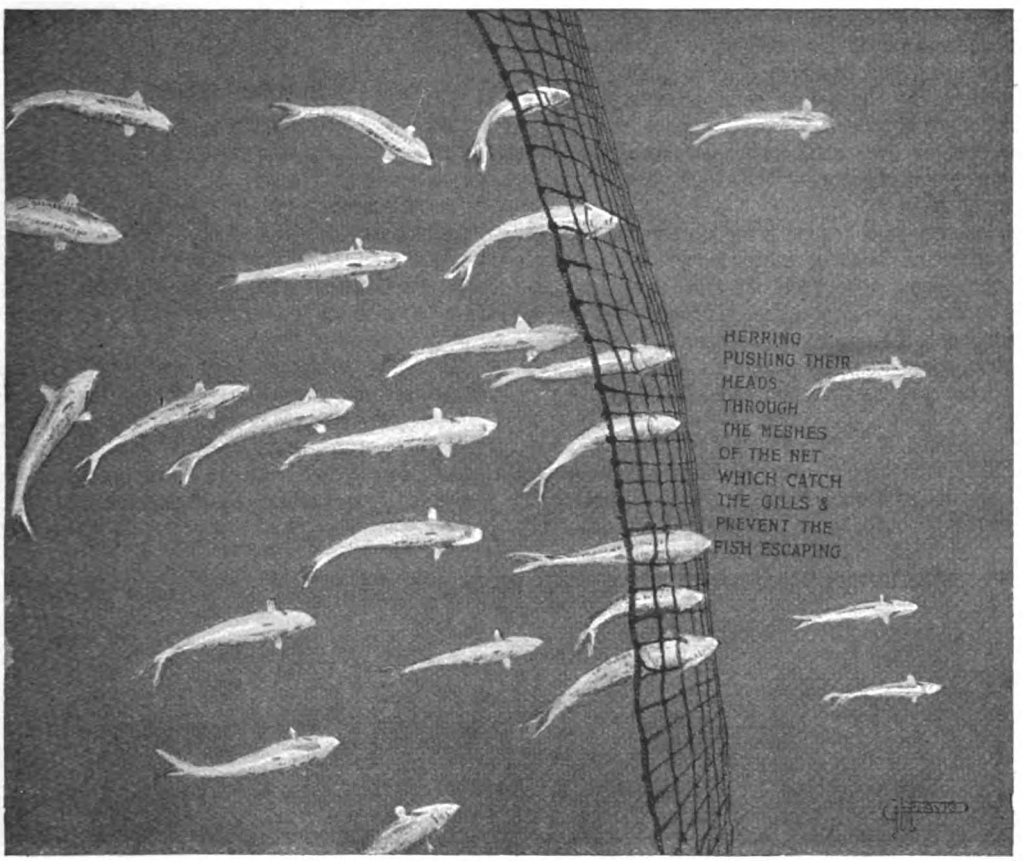
Mining can be divided into two broad categories: metalliferous and non-metalliferous. The most important and certainly that in which the largest number of people are employed, of the metalliferous mining industries is that of iron. Deposits of iron ore are found in many countries. In Great Britain iron has been mined for centuries, and occurs in various forms as oxides and carbonates of the metal. Iron is mined in large quantities in Germany, Sweden, Styria, Spain (which possesses a most valuable ore known as brown hæmatite or "Rubio" ores), the United States of America (where the Lake Superior ores are especially valuable), India, and many other countries.

Copper is largely mined in Spain, Mexico, Italy, the United States, Newfoundland, etc.

Tin has been obtained since prehistoric times from Cornwall, and is still worked there. Over one half of the tin of the world comes from the various countries of the British Empire, and it is also found in the Dutch East Indies and in Bolivia.

Zinc is largely a product of Australia; manganese is mined in Sweden.

The chief sources of silver are Mexico, the United States of America, and Australia. Gold is found in two forms: as alluvial deposits in Australia, the Yukon district of Canada, and California; as a rock deposit in the Transvaal, India, etc.



HOW HERRINGS ARE CAUGHT.

Nets of fine mesh cotton are stretched in the known courses of the fish. The herrings push their heads into these nets, but the mesh is too small to allow their bulk and fins to pass; nor can they back out for the string catches their gills and holds them firmly. Thousands of fish, in fact, are literally drowned.

Of non-metalliferous substances obtained by mining we may mention chalk, clay, limestone, salt, oil, various building stones, and most important of all—coal.

Coal mining is followed in many countries of the world. The greatest amount of coal is obtained in the United States of America, Great Britain and Germany being the next greatest producers. Large quantities are also obtained in Austria, France, Belgium,

Russia, Japan, Canada, etc., but even in agricultural countries such as Holland, a considerable coal-mining industry exists.

The manufactures of the world are so many in number and so different in character that even the briefest treatment of them would be impossible. It is however clear that those manufactures, for instance, connected with iron must be established, often in regions where that metal is found, but, more important, where coal is abundant. Although, for instance, much iron ore is found in Sweden, it is mostly exported and worked up into the various manufactured articles of iron and steel in countries like Germany and Great Britain, where coal is abundant.

For the same reason an enormous cotton industry has sprung up in Lancashire, which is also easy of access to the chief cotton-producing country—the United States of America. The climate, moreover, which in cotton manufacture must be moist to avoid the breakage of the yarn, is suitable.

German Dyes

But in a good many cases there seems to be no obvious reason why a particular industry should be established in one district rather than in another. We may cite the jewellery industry centred in Birmingham and London. Neither place has any particular advantage over almost any other that could be mentioned. Again the chemical dye industry was, before the war, practically monopolised by Germany. There are no geographical or natural reasons for this, and during the continuance and since the end of the war an attempt has been made to establish a British dye industry.

Insular Britain

The insular position of Britain, and its situation at the extreme western extremity of the Old World, and, furthermore, as approximately at the centre of the land hemisphere of the globe, has given it an importance as the great transporting country that has done more, perhaps, than anything else to raise us to the first position among the nations of the world.

Locally, transport industries will naturally tend to be concentrated at seaports and at what may be termed "nodal" positions which communicate with many different places in all directions. And in all countries with a long seaboard transport industries have sprung up. C. J. S.

ROUNDING UP CATTLE.

The Prince of Wales on a Ranch during his visit to Canada in the autumn of 1919. Ranching, broadly speaking, is the industry connected with the breeding and rearing of sheep and cattle on unenclosed areas.

Continued from page 366.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.

(M. A. Lewenz, M.A.[Lond.]).

ARITHMETIC.—XV

115. To find the value of a rectangular solid.

Suppose the dimensions of the solid are 5 in. by 4 in. by 3 in.

The edges may be divided into parts of 5, 4, and 3 in. respectively.

Parallel planes through these points of division will divide the solid into cubes, each of which is a cubic inch. There will be as many layers of cubes as there are inches in the height, viz. 3; each layer consists of as many cubes as there are inches in the length multiplied by the inches in the breadth, i.e. of $5 \times 4 = 20$ **cubes.**

Hence **the number of cubic inches (or feet, etc.) in a rectangular solid equals the continued product of the number of inches (or feet, etc.) in its length, breadth and height.**

Clearly the case in which the length, breadth, and height cannot be expressed in terms of integers may be proved by a process of reasoning similar to that applied in the case of areas.

Example :—

Find the volume of a cistern $2\frac{1}{2}$ yd. long, 4 ft. broad, and $5\frac{1}{2}$ ft. deep.

Here, as before, we must express all dimensions in terms of the same unit.

Since $2\frac{1}{2}$ yd. $= 7\frac{1}{2}$ ft.

$$\text{volume} = 7\tfrac{1}{2} \times 4 \times 5\tfrac{1}{2} \text{ cub. ft.} = \frac{15}{2} \times 4 \times \frac{11}{2} \text{ cub. ft.}$$

$$= \mathbf{165 \text{ cub. ft.}}$$

116. Since volume = length × breadth × height

$$\therefore \frac{\text{volume}}{\text{height}} = \frac{\text{length} \times \text{breadth} \times \text{height}}{\text{height}}$$

$$= \text{length} \times \text{breadth}.$$

Hence, **given the volume and one dimension of the volume, we can find the area of the surface bounded by the other two dimensions.**

Again—

$$\frac{\text{volume}}{\text{length} \times \text{breadth}} = \frac{\text{length} \times \text{breadth} \times \text{height}}{\text{length} \times \text{breadth}}$$

$$= \text{height}.$$

Hence, **given the volume and the area of one surface of the volume, we can find the third dimension.**

Example :—

The volume of a box is 540 cub. in. and the surface on which it stands is 27 sq. in.; find its height.

$$\frac{540}{27} = \mathbf{20 \text{ in.}}$$

117. Carpeting floors and papering walls.

If l = length of room, b = breadth of room, and h = height of room.

The area to be carpeted $= l \times b$.

If x be the width of the carpet, then length of carpet required $= \frac{l \times b}{x}$.

Example :—

What will it cost to carpet a room 27 ft. long and 21 ft. broad with a carpet $\frac{3}{4}$ yd. wide, if a rim of $1\frac{1}{2}$ ft. is to be uncarpeted all round by the walls and the carpet cost 5s. 6d. a yard?

Area to be carpeted $= 24 \times 18$ sq. ft. (for 3 ft. will come off the length—$1\frac{1}{2}$ ft. each end, and the same with the breadth).

$$\therefore \text{cost for carpeting} = \frac{24 \times 18}{2\frac{1}{4}} \times 5\tfrac{1}{2} \text{ shillings}$$

$$= \frac{24 \times 18 \times 11 \times 4}{9 \times 2} \text{ shillings} = 1056\text{s.}$$

$$= \mathbf{£52\ 16\text{s.}}$$

The area to be papered in a room, disregarding doors and windows, is two walls whose area $= l \times h$ and two walls whose area $= b \times h$.

$\therefore$ total area $= 2lh + 2bh = 2h(l + b)$.

Example :—

Find the cost of papering a room 19 ft. long, 15 ft. wide, $10\frac{1}{2}$ ft. high, with paper 2 ft. wide, costing 2s. 6d. the piece of 12 yd.

$$\text{Cost} = \frac{(19 + 15) \times 2 \times \frac{21}{2}}{2} \times \frac{1}{3} \times \frac{1}{12} \text{ of } \frac{5}{2} \text{ shillings}$$

$$= \mathbf{£1\ 4\text{s.}\ 9\tfrac{1}{2}\text{d.}}$$

118. A large class of questions can be solved by the **Unitary Method,** which will be clear from the following examples.

Examples :—

(1) If 7 articles cost 1s. 9d., how much will 10 articles cost at the same rate?

7 articles cost 21d.

$\therefore$ 1 article costs $\frac{21}{7}$d. = 3d.

$\therefore$ 10 articles cost 3d. $\times$ 10 = 30d. = **2s. 6d.**

(2) If a man cycles 75 yd. in 5 seconds, how long will it take him to ride a mile at the same rate ?

He rides 75 yd. in 5 seconds

$\therefore$ rides 1 yd. in $\frac{5}{75}$ seconds

$\therefore$ rides 1 mile in $\frac{5}{75} \times 1760$ seconds

= **1 min. 57⅓ sec.**

(3) If 5 men or 8 women can do a piece of work in 21 days, how long will it take 7 men and 4 women to do a piece of work twice as great ?

Work of 5 men = work of 8 women,

$\therefore$ work of 1 man = work of $\frac{8}{5}$ women,

$\therefore$ work of 7 men = work of $\frac{7 \times 8}{5}$ women

$= \frac{56}{5}$ women,

$\therefore$ work of 7 men and 4 women

= work of $\left(\frac{56}{5} + 4\right)$ women

= work of $\frac{76}{5}$ women.

Now 8 women do the piece of work in 21 days,

$\therefore$ 8 women do twice the piece of work in 42 days,

$\therefore$ 1 woman does twice the piece of work in $\frac{42}{8}$ days, $\therefore$ $\frac{76}{5}$ women do twice the piece of work in $\frac{42}{8} \times \frac{76}{5}$ days.

= **79 days 19 hours 12 min.**

(4) A bankrupt's liabilities are £5,374 15s. 9d., of which £117 12s. 3d. have to be paid in full. His assets are £4,498 11s. 10d. How much in the pound can he pay his creditors ?

£5,374 15s. 9d. — £117 12s. 3d. = £5,257 3s. 6d = liabilities after paying £117 12s. 3d.

£4,498 11s. 10d. — £117 12s. 3d. = £4,380 19s. 7d. = assets after paying £117 12s. 3d.

For a debt of £5,257 3s. 6d.

he can pay . . . £4,380 19 7

For a debt of £1 he can pay . £4,380 19 7 / £5,257 3 6

$\frac{\text{£4,380 19s. 7d.}}{\text{£5,257 3s. 6d.}} = \text{£}\frac{4380\frac{7}{240}}{5257\frac{42}{240}} = \text{£}\frac{1051435}{1261722}$

= **16s. 8d.**

(5) A, B, and C are three workmen : A can do half a piece of work in 3 hours, being twice as much as B can do ; and A, B, and C together do the whole in 2½ hours. Show that C can do in 5 hours as much as B can do in 9 hours.

In 3 hours A does ½ piece of work,

$\therefore$ in 1 hour A does ⅙ piece of work,

$\therefore$ in 2½ hours A does $\frac{5}{12}$ piece of work,

$\therefore$ in 2½ hours B and C do $\frac{7}{12}$ piece of work.

Now in 3 hours B does ¼ piece of work,

$\therefore$ in 1 hour B does $\frac{1}{12}$ piece of work,

$\therefore$ in 2½ hours B does $\frac{5}{24}$ piece of work,

$\therefore$ in 2½ hours C does $(\frac{7}{12} - \frac{5}{24}) = \frac{9}{24}$ piece of work = ⅜ piece of work.

Since in 1 hour B does $\frac{1}{12}$ piece of work,

$\therefore$ in 9 hours B does ¾ piece of work.

Since in 2½ hours C does ⅜ piece of work,

$\therefore$ in 1 hour C does $\frac{3}{20}$ piece of work,

$\therefore$ in 5 hours C does ¾ piece of work,

i.e. C does in 5 hours what B does in 9 hours.

Exercise 39

(1) Find the cost of painting the walls and ceiling of a room 35 ft. 4 in. long, 17 ft. 6 in. high, and 20 ft. broad, at a cost of 3½d. a square yard.

(2) Find the cost of papering the same room with paper 30 in. wide at 4s. 6d. a piece of 12 yards, there being three windows 12 ft. by 3 ft. and two doors 8 ft. by 4½ ft.

(3) Suppose the cost of a carpet in a room 25 ft. long at 5s. a square yard be £6 5s., find the breadth of the room.

(4) A reservoir is 24 ft. 8 in. long by 12 ft. 9 in. wide ; how many cubic feet of water must be drawn off to make the surface sink 2 ft. ?

(5) How many paving blocks, each 1 ft. long and $1\frac{4}{5}$ ft. wide, will be required to pave a road 45 ft. wide, surrounding a square the side of which is 225 ft. ?

Exercise 40

(1) A cistern is fed by a spout which can fill it in 2 hours ; how long would it take to fill it if it has a leak which would empty it in 8 hours ?

(2) If a bankrupt pays 6s. 8d. in the pound, what will be received for a debt of £1,839 8s. ?

(3) If 36 men working 8 hours a day for 16 days can dig a trench 72 yards long, 18 wide, and 12 deep, in how many days will 32 men working 12 hours a day dig a trench 64 yards long, 27 wide, and 18 deep ?

(4) If a bankrupt's liabilities are £37,581 17s. 6d., and his assets are £8,937 16s. 8d., what can he pay in the £, and how much should a creditor receive to whom he owes £39 17s. 5d. ? Give each answer to the nearest penny.

(Question 4 is from the London Matriculation Examination.)

Key to Exercise 38

(1) (*a*) £5,796 13s. 4d. ; (*b*) £579,666 13s. 4d. ; (*c*) £2,898 6s. 8d. ; (*d*) £14,491 13s. 4d. ; (*e*) £11,593 6s. 8d.

(2) (*a*) £1 13s. ; £19 16s. ; (*b*) £2 3s. 6d. ; £26 2s. ; (*c*) £4 6s. 3d. ; £51 15s. ; (*d*) 11s. 9d. ; £7 1s.

(3) (*a*) 2s. 11d. ; 14s. 7d. ; (*b*) 12s. 6d. ; £3 2s. 6d. ; (*c*) £1 19s. 7d. ; £9 17s. 11d. ; (*d*) £3 7s. 6d. ; £16 17s. 6d.

(4) £20 6s. 1d. ; £235 1s. 8d. ; £32 14s. 3d. ; £152 5s. 2d.

(5) (*a*) £2 10s. ; (*b*) £7 15s. ; (*c*) £12 10s. ; (*d*) £27.

(6) (*a*) £2 7s. 6d. ; (*b*) £5 5s. ; (*c*) £10 5s. ; (*d*) £17 17s. 6d.

(7) (*a*) £1 16s. 9d. ; (*b*) £42 10s. 6d. ; (*c*) £94 10s.

(8) (i.) (*a*) £2 7s. 11d. ; (*b*) £23 19s. 2d. ; (*c*) £5 19s. 9½d. ; (*d*) £1 10s. 2½d. ; (ii.) (*a*) £36 17s. 6d. ; (*b*) £368 15s. ; (*c*) £92 3s. 9d. ; (*d*) £23 4s. 7½d.

(9) (*a*) £45 12s. 6d. ; (*b*) £64 12s. 8½d.

(10) (*a*) £71 14s. 7d. ; (*b*) £161 1s. 3½d.

(11) (*a*) 3s. 6d. ; (*b*) 9s. ; (*c*) 16s. 8d. ; (*d*) £2 4s.

(12) (*a*) £20 3s. 4d. ; (*b*) £62 6s. 8d. ; (*c*) £117 6s. 8d.

(13) (*a*) £1 5s. 8d. ; £25 13s. 4d. ; (*b*) £3 19s. 4d. ; £79 6s. 8d. ; (*c*) £7 9s. 4d. ; £149 6s. 8d.

(14) (*a*) £847 ; (*b*) £1,210 ; (*c*) £1,734 6s. 8d.

M. A. L.

ALGEBRA.—XV

98. Simultaneous Equations of the Second Degree.

First consider two equations containing two unknown quantities.

No general rule can be given applicable to all such equations, but the following examples will illustrate some of the methods.

Examples :—

(1) Solve $2x + y = 3$ ..... (i)
$x^2 + xy - y^2 = 1$ ..... (ii)

In such cases where one equation is of the first degree it is usually simplest to proceed as follows: From (i) $y = 3 - 2x$.
Substitute this value in (ii)
Then $x^2 + x(3 - 2x) - (3 - 2x)^2 = 1$
$\therefore x^2 - 3x + 2 = 0$
$\therefore (x - 2)(x - 1) = 0$
This gives the values $x = 1$, $x = 2$.
Substitute these in (i)
If $x = 1$ $y = 3 - 2 = 1$
If $x = 2$ $y = 3 - 4 = -1$
Hence the solutions are $x = 1$, $y = 1$, and $x = 2$, $y = -1$.

(2) Solve $x^2 + xy = 12$ ..... (i)
$xy - 2y^2 = 1$ ..... (ii)

Hence $x^2 + xy = 12(xy - 2y^2)$
$\therefore x^2 - 11xy + 24y^2 = 0$
$\therefore (x - 3y)(x - 8y) = 0$
$\therefore x - 3y = 0$ or else $x - 8y = 0$
If $x - 3y = 0$, we have from (i)
$9y^2 + 3y^2 = 12$
$\therefore y^2 = 1$ $\therefore y = \pm 1$ $\therefore x = \pm 3$
If $x - 8y = 0$, we have from (i)
$64y^2 + 8y^2 = 12$
$\therefore y^2 = \frac{1}{8}$ $\therefore y = \pm \sqrt{\frac{1}{8}}$ $\therefore x = \pm 8\sqrt{\frac{1}{8}}$

(3) Solve $x + y = 15$ ..... (i)
$xy = 36$ ..... (ii)
Square (i) then $(x + y)^2 = 225$
Subtract four times (ii), then $(x - y)^2 = 81$
$\therefore x - y = \pm 9$ ..... (iii)
Now consider (iii) in connection with (i)
If $x - y = 9$ and $x + y = 15$ } then $x = 12$ and $y = 3$
If $x - y = -9$ and $x + y = 15$ } then $x = 3$ and $y = 12$

(4) Solve $x - y = 5$ ..... (i)
$xy = 126$ ..... (ii)
Square (i) and add four times (ii)
then $(x + y)^2 = 529$
$\therefore x + y = \pm 23$
considering this in connection with (i)
If $x + y = 23$ and $x - y = 5$ } then $x = 14$ and $y = 9$
If $x + y = -23$ $x - y = 5$ } then $x = -9$ and $y = -14$

(5) Solve $x^2 + y^2 = 89$ ..... (i)
$xy = 40$ ..... (ii)

Multiply (ii) by 2 and first add it and then subtract it from (i).
Then $(x + y)^2 = 169$ $\therefore x + y = \pm 13$
$(x - y)^2 = 9$ $\therefore x - y = \pm 3$
This gives us 4 solutions
$x + y = 13$, $x - y = 3$ } then $x = 8$, $y = 5$
$x + y = -13$, $x - y = 3$ } then $x = -5$, $y = -8$
$x + y = 13$, $x - y = -3$ } then $x = 5$, $y = 8$
$x + y = -13$, $x - y = -3$ } then $x = -8$, $y = -5$

(6) Solve $x + y = 15$ ..... (i)
$x^2 + y^2 = 125$ ..... (ii)
Subtract (ii) from the square of (i)
then $2xy = 100$ ..... (iii)
First adding and then subtracting (iii) from (ii), we get
$(x + y)^2 = 225$ $\therefore x + y = \pm 15$
$(x - y)^2 = 25$ $\therefore x - y = \pm 5$
Hence we have four cases—
$x + y = 15$, $x - y = 5$ } then $x = 10$, $y = 5$
$x + y = -15$, $x - y = 5$ } then $x = -5$, $y = -10$
$x + y = 15$, $x - y = -5$ } then $x = 5$, $y = 10$
$x + y = -15$, $x - y = -5$ } then $x = -10$, $y = -5$

(7) Solve $x^3 - y^3 = 218$ ..... (i)
$x - y = 2$ ..... (ii)
Dividing (i) by (ii) $x^2 + xy + y^2 = 109$ .. (iii)
squaring (ii) $x^2 - 2xy + y^2 = 4$ .. (iv)
subtracting (iv) from (iii) $3xy = 105$
$\therefore xy = 35$ ..... (v)
From (ii) and (v) $x = 7$, $y = 5$
$x = -5$, $y = -7$

(8) Solve $x^2 + xy + y^2 = 76$ ..... (i)
$x^4 + x^2y^2 + y^4 = 2128$ ..... (ii)
Divide (ii) by (i) then $x^2 - xy + y^2 = 28$... (iii)
subtracting (iii) from (i)
$2xy = 48$ $\therefore xy = 24$ ..... (iv)
adding (iv) to (i) $(x + y)^2 = 100$ $\therefore x + y = \pm 10$
subtracting (iv) from (iii) $(x - y)^2 = 4$ $\therefore x - y = \pm 2$
Hence we have four solutions
$x + y = 10$, $x - y = 2$ } then $x = 6$, $y = 4$
$x + y = -10$, $x - y = 2$ } then $x = -4$, $y = -6$
$x + y = 10$, $x - y = -2$ } then $x = 4$, $y = 6$
$x + y = -10$, $x - y = -2$ } then $x = -6$, $y = -4$

(9) Solve $\frac{a^2}{x^2} + \frac{b^2}{y^2} = 10$ ..... (i)
$\frac{ab}{xy} = 3$ ..... (ii)

Multiply (ii) by 2 and first add and then subtract it from (i), then

$$\left(\frac{a}{x}+\frac{b}{y}\right)^2 = 16 \therefore \frac{a}{x}+\frac{b}{y} = \pm 4$$

and $$\left(\frac{a}{x}-\frac{b}{y}\right)^2 = 4 \therefore \frac{a}{x}-\frac{b}{y} = \pm 2$$

Thus we have

$$\left.\begin{aligned}\frac{a}{x}+\frac{b}{y} &= 4\\ \frac{a}{x}-\frac{b}{y} &= 2\end{aligned}\right\} \text{then } x = \frac{a}{3} \text{ and } y = b$$

$$\left.\begin{aligned}\frac{a}{x}+\frac{b}{y} &= -4\\ \frac{a}{x}-\frac{b}{y} &= 2\end{aligned}\right\} \text{then } x = -a \text{ and } y = -\frac{b}{3}$$

$$\left.\begin{aligned}\frac{a}{x}+\frac{b}{y} &= 4\\ \frac{a}{x}-\frac{b}{y} &= -2\end{aligned}\right\} \text{then } x = a \text{ and } y = \frac{b}{3}$$

$$\left.\begin{aligned}\frac{a}{x}+\frac{b}{y} &= -4\\ \frac{a}{x}-\frac{b}{y} &= -2\end{aligned}\right\} \text{then } x = -\frac{a}{3} \text{ and } y = -b$$

(10) Solve $x^2 - xy = 8x + 3$ ..... (i)
$xy - y^2 = 8y - 6$ ..... (ii)

Subtract (ii) from (i) then $(x-y)^2 = 8(x-y) + 9$
$\therefore (x-y)^2 - 8(x-y) - 9 = 0$
$\therefore (x-y-9)(x-y+1) = 0$
$\therefore x - y = 9$ or $x - y = -1$
If $x - y = 9$, then from (i)
$x^2 - x^2 + 9x = 8x + 3$
$\therefore x = 3$ and $\therefore y = -6$
If $x - y = -1$, then from (i)
$x^2 - x^2 - x = 8x + 3$
$\therefore x = -\frac{1}{3}$ and $\therefore y = \frac{2}{3}$

(11) Solve $x + y = 6$ ..... (i)
$(x^2 + y^2)(x^3 + y^3) = 1440$ ..... (ii)

Let $x = 3 + z$ then from (1) $y = 3 - z$
Hence (ii) becomes
$\{(3+z)^2 + (3-z)^2\}\{(3+z)^3 + (3-z)^3\} = 1440$
which reduces to
$z^4 + 12z^2 - 13 = 0$
$(z^2 + 13)(z^2 - 1) = 0$
$\therefore z = \pm\sqrt{-13}$ or $z = \pm 1$
Hence $x = 4, y = 2$; $x = 2, y = 4$
$x = 3 + \sqrt{-13}, \ y = 3 - \sqrt{-13}$,
$x = 3 - \sqrt{-13}, \ y = 3 + \sqrt{-13}$

(12) Solve $3x^2 + 4xy - y^2 = 14$ ..... (i)
$2x^2 + 5xy + 6y^2 = 9$ ..... (ii)

Put $y = mx$, then from (i)
$(3 + 4m - m^2)x^2 = 14$ ..... (iii)
and from (ii)
$(2 + 5m + 6m^2)x^2 = 9$ ..... (iv)
dividing (iii) by (iv), we have
$$\frac{3 + 4m - m^2}{2 + 5m + 6m^2} = \frac{14}{9}$$
whence $93m^2 + 34m + 1 = 0$
$\therefore (31m + 1)(3m + 1) = 0$
$\therefore m = -\frac{1}{31}$ or $m = -\frac{1}{3}$

First take $m = -\frac{1}{3}$, then from (iv)
$\left(2 - \frac{5}{3} + \frac{2}{3}\right)x^2 = 9$
$\therefore x = \pm 3$ and $\therefore y = \mp 1$

Next take $m = -\frac{1}{31}$, then from (iii)
$\left(3 - \frac{4}{31} - \frac{1}{961}\right)x^2 = 14$
$\therefore x = \pm\frac{31}{\sqrt{197}}$ and $\therefore y = \mp\frac{1}{\sqrt{197}}$

This method may always be used with homogeneous equations of the same degree. It is not applicable, of course, to equations which are of the same degree, but which are not homogeneous.

Exercise 21

Solve

(1) $x + y = 51$, $xy = 578$
(2) $x - y = 18$, $xy = 1075$
(3) $3x - 4y^2 = 14$, $2x + 3y^2 = 32$
(4) $\frac{a^2}{x^2} + \frac{b^2}{y^2} = 10$, $\frac{ab}{xy} = 3$
(5) $x + y = 8xy$, $x^2 + y^2 = 40\,x^2y^2$
(6) $x^3 + y^3 = 9$, $x^2 - xy + y^2 = 3$
(7) $x + y = 9$, $x^2 + xy + y^2 = 61$
(8) $x^4 + x^2y^2 + y^4 = 7371$, $x^2 - xy + y^2 = 63$
(9) $x - y = 10$, $x^2 - 2xy - 3y^2 = 84$
(10) $x^2 + 4y^2 + 80 = 15x + 30y$, $xy = 6$
(11) $x^2 - 4y^2 = 13$, $2x + 3y = 5$
(12) $2x^2 + 5x - 6 = 0$, $y = 2x - 1$

Give the values of each root correct to 2 significant figures.

(Questions 11 and 12 are from the *London Matriculation Examination*.)

Key to Exercise 18

(1) $a, \frac{a}{2}(-1 + \sqrt{-3}), \frac{a}{2}(-1 - \sqrt{-3}), -2a, -a(-1 + \sqrt{-3}), -a(-1 - \sqrt{-3})$.
(2) $2, -3, \frac{-1}{2} \pm \sqrt{-35}$. (3) $\pm\sqrt{(a+b)}$.
(4) $a, b, \frac{1}{2}(a+b) \pm \frac{1}{14}(a-b)\sqrt{-7}$.
(5) $-1, \frac{1}{4}\left[1 + \sqrt{5} \pm \sqrt{(2\sqrt{5} - 10)}\right], \frac{1}{4}\left[1 - \sqrt{5} \pm \sqrt{(-2\sqrt{5} - 10)}\right]$
(6) $\pm 1, \frac{1}{2}(-7 \pm 3\sqrt{5})$. (7) $1, -1, -\frac{1}{2} \pm \frac{1}{2}\sqrt{-3}, \frac{1}{2} \pm \frac{1}{2}\sqrt{-3}$. (8) m, n.

Key to Exercise 19

(1) $x = 3, y = 5$. (2) $x = 10, y = 3$. (3) $x = 12, y = 8$. (4) $x = 3, y = 5$. (5) $x = a, y = b$. (6) $x = 3, y = 6$. (7) $x = \frac{2}{3}, y = 3$. (8) $x = a, y = b$. (9) $x = b^n, y = a^n$.

M. A. L.

GEOMETRY.—XIV

Proposition 74. Theorem

The tangent at any point on a circle is at right angles to the radius drawn to that point.

Let A be any pt. on a ⊙ with centre O.

Let T A T′ be the tangent at A.

It is required to prove that O A is ⊥ to T A T′.

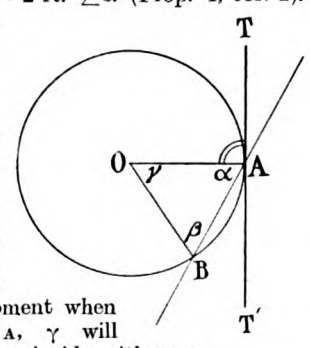
Proof.—Take any other pt. B on the circumference. Join O B, B A.

Then $\alpha + \beta + \gamma = 2$ rt. ∠s. (Prop. 4, cor. 2).

Now △ O A B is isos.

∴ $\alpha = \beta$ (Prop. 6).

∴ $2\alpha + \gamma = 2$ rt. ∠s.



Now suppose the pt. B to move along the ⊙ in the direction of pt. A.

The ∠s α and β will grow larger and the ∠ γ will diminish. At the moment when B coincides with A, γ will vanish, for O B will coincide with O A.

But $2\alpha + \gamma = 2$ rt. ∠s.

∴ when $\gamma = 0$, $2\alpha = 2$ rt. ∠s.

∴ $\alpha = 1$ rt. ∠.

i.e. O A is ⊥ to T A T′.

Alternative Proof.

Let straight line T A T′ be drawn ⊥ to O A at pt. A on the circumference of a ⊙ with centre O. Take any pt. D on A T. Join O D.

$\alpha + \beta < 2$ rt. ∠s (2 ∠s of a △)

$\alpha = 1$ rt. ∠ ∴ $\beta < 1$ rt. ∠ ∴ $\beta < \alpha$

∴ O D > O A. (Prop. 11).

i.e. O D > radius of ⊙ ∴ D lies outside ⊙.

Similarly, we may show that any other pt. on T A T′, except A, lies outside the ⊙ ∴ T A T′ touches the ⊙ at A, i.e. T A T′ is the tangent at A.

Further, any other straight line through A must cut the ⊙.

Let B A C be some other straight line through A, not ⊥ to O A.

From O draw O P ⊥ to B A C (Prop. 22).

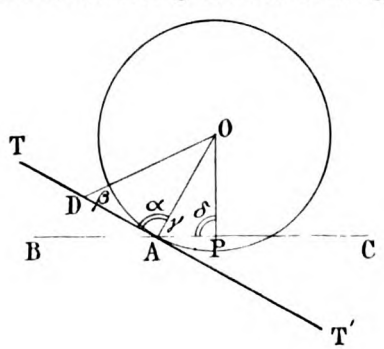
then δ is a rt. ∠.

$\gamma + \delta < 2$ rt. ∠s (2 ∠s of a △).

∴ $\gamma < 1$ rt. ∠ ∴ $\gamma < \delta$.

∴ O P < O A (Prop. 11).

i.e. O P < radius of ⊙ ∴ P lies within ⊙



i.e. at least one pt. in B A C lies within ⊙

∴ B A C cuts the ⊙.

Corollary.

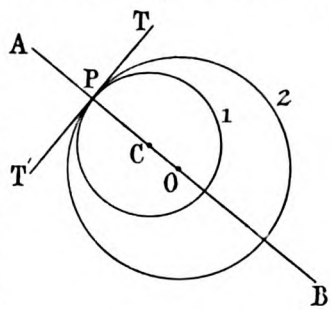
1. *Only one tangent to a circle can be drawn at one point (since only one line can be drawn ⊥ to another line at one pt.).*

2. *The ⊥ drawn to any tangent from the centre passes through the point of contact (since the radius is such a ⊥ and only one ⊥ can be drawn from one pt.).*

Proposition 75. Theorem

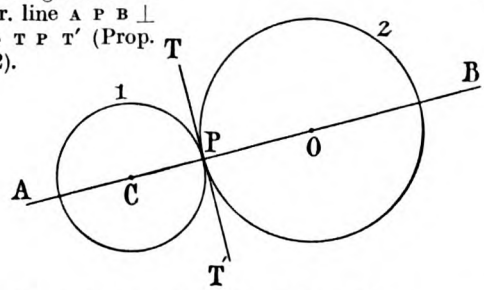
If two circles touch one another, the straight line joining their centres passes through their point of contact.

Let ⊙s 1 and 2 having centres C and O have a common tangent T P T′ at the pt. P.



It is required to prove that the str. line joining C O passes through P.

Proof.—Through P draw str. line A P B ⊥ to T P T′ (Prop. 22).



Then C the centre of 1 lies on A P B. } (Prop. 74).
and O the centre of 2 lies on A P B }

∴ A P B passes through C and O

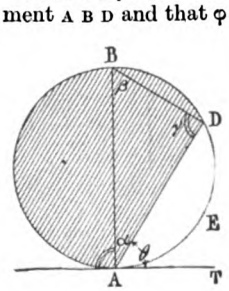
i.e. the str. line joining C O passes through P.

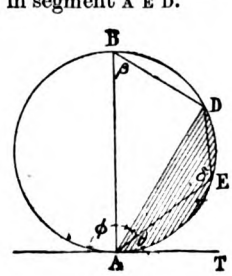
Proposition 76. Theorem

If through the point of contact of a tangent to a circle a chord be drawn, the angles between the chord and the tangent are equal to the angles in the alternate segments; i.e. the acute angle equals the angle in the greater segment and the obtuse angle equals the angle in the smaller segment.

Let A T be a tangent to the ⊙ at A and A D any chord through A.

It is required to prove that $\theta = \angle$ in segment A B D and that $\varphi = \angle$ in segment A E D.



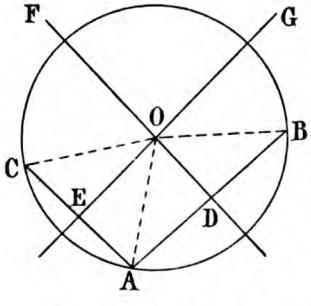


Proof.—Fig. 1. Draw diameter A B. Join B D.
Then β, the ∠ in the segment A B D is the same size wherever B may lie on arc A B D (Prop. 66).
γ = 1 rt. ∠ (∠ in a semicircle) (Prop. 70).
∴ α + β = 1 rt. ∠ (Prop. 4, cor. 2).
but α + θ = 1 rt. ∠ (∵ A T is a tangent) (Prop. 74).
∴ θ = β.
Fig. 2.—Take ∠ δ in segment D E A.
A B D E is a cyclic quadrilateral
∴ β + δ = 2 rt. ∠s (Prop. 67).
but φ + θ = 2 rt. ∠s (Prop. 1).
∴ φ + θ = β + δ
Now we have just proved that θ = β
∴ φ = δ.

Proposition 77.—Problem

Being given a circle, to find its centre.

Through any part A on the circumference of the given ○ draw two chords A B, A C.



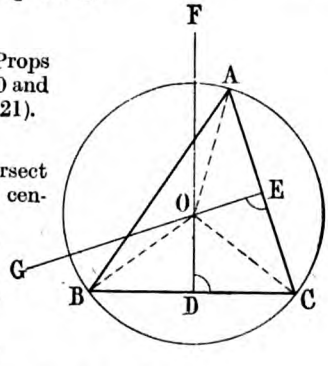
Bisect A B at D and A C at E (Prop. 20).
Through D draw D F ⊥ to A B
Through E draw E G ⊥ to A C
} (Prop. 21).
A B, A C are not ∥, ∴ D F, E G which are ⊥ to them are not ∥.
∴ D F, E G intersect at some pt. O.
Then O is the centre of the ○.

Proof.
All pts. equidistant from A and B must lie on D F
∴ centre of ○ must lie on D F.
Similarly centre of ○ must lie on E G.
∴ centre of circle lies at O, the pt. of intersection of D F and E G.

Proposition 78.—Problem

To describe a circle about a given triangle; i.e. to describe a circle passing through three fixed points.

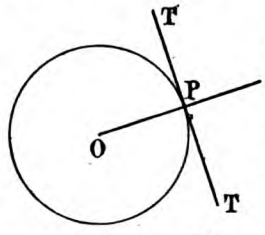
Let A B C be the given △.
Draw D F bisecting B C at rt. ∠s
Draw E G bisecting A C at rt. ∠s
} (Props 20 and 21).
D F and E G intersect at O, which is the centre of the ○.



Proof.—All pts. equidistant from B and C lie on D F.
∴ the centre must lie on D F.
All pts. equidistant from C and A lie on E G.
∴ the centre must lie on E G.
∴ O, the pt. of intersection of D F and E G, is the centre.

Proposition 79.—Problem

To draw a tangent at a given point on a circle.



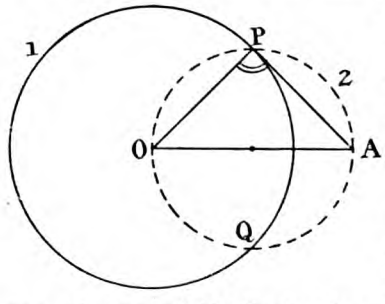
Let P be the given pt. on the ○ with centre O.
Draw the radius P O.
At P draw T P T′ ⊥ to O P.
Then T P T′ is the tangent at P since it is ⊥ to the radius at P.

Proposition 80.—Problem

To draw a tangent to a given circle from a given point outside it.

Let O be the centre of the given ○ 1.
Let A be the pt. outside it.
Join O A.
On O A as diameter describe ○ 2 cutting 1 at P and Q.
Join A P. Then A P is required tangent.

Proof.—Join O P.
O P A is a rt. ∠ (∠ in a semicircle) (Prop. 71).
∴ A P is a tangent since it is ⊥ to radius O P.
If A Q were joined, A Q would also be a tangent.

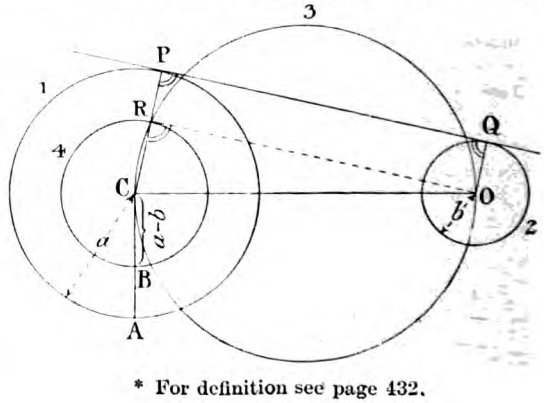


Corollary.—*The two tangents drawn to a ○ from the same pt. are equal* (*for the rt. ∠d △s, A O P, A O Q have their hypotenuses equal and O P = O Q and ∴ △ A O P ≡ △ A O Q*).

Proposition 81.—Problem

To draw a direct common tangent to two given circles.*

Let 1 and 2 be the given ○s. Let their centres be C and O, and the radii be of lengths *a* and *b* respectively.
Join C O. On C O as diameter describe ○ 3.
From the radius A C of length *a*, cut off A B = *b*, the length of the radius of 2. Then C B = *a* − *b*.



* For definition see page 432.

With centre C and radius C B ($= a - b$) describe ⊙ 4 cutting ⊙ 3 in R.

Join C R and produce it to cut ⊙ 1 in P.

Draw O Q ∥ to C P (Prop. 29).

Join P Q. Then P Q is the required direct tangent.

Proof.—Join O R.

C P $= a$
C R $= a - b$ $\Big\}$ ∴ R P $= b$

∴ R P $=$ O Q. But R P is ∥ to O Q

∵ P Q and R O are equal and ∥ (Prop. 30).

i.e. R P Q O is a ▱.

∠ C R O is a rt. ∠ (∠ in a semicircle) (Prop. 70).

∠ C R O $=$ corresponding ∠ R P Q (Prop. 26).

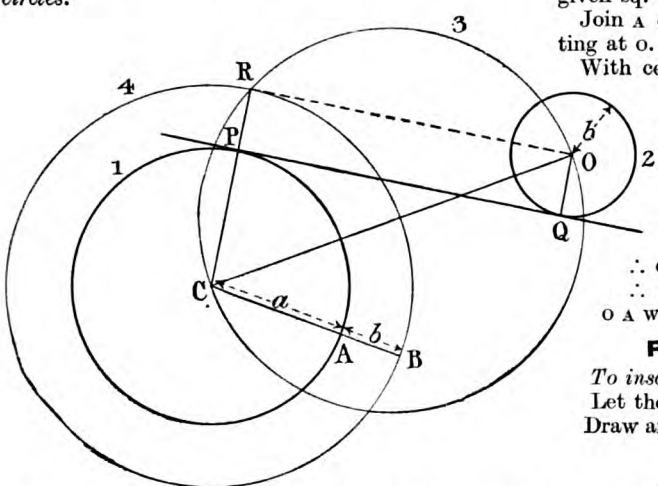
∴ R P Q O is a rectangle.

∴ P Q is ⊥ to the radii C P, O Q

i.e. P Q touches the ⊙s 1 and 2.

Proposition 82.—Problem

To draw a transverse common tangent to two given circles.*



Let 1 and 2 be the given ⊙s. Let their centres be C and O, and their radii a and b in length respectively.

Join C O. On C O as diameter describe ⊙ 3.

Produce radius C A, making A B $= b$, the length of the radius of 2.

With centre C and radius C B ($= a + b$) describe ⊙ 4 cutting 3 at R. Join C R cutting 1 at P.

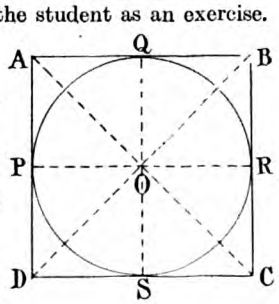
Draw O Q ∥ to R P (Prop. 29).

Join P Q. Then P Q is the required transverse tangent.

The **proof** is left to the student as an exercise.

Proposition 83.—Problem

To inscribe a circle in a given square.



Let A B C D be the given sq.

Join A C, B D cutting at O.

From O draw O P ⊥ to A D (Prop. 22).

With centre O and radius O P describe a ⊙.

This is the required ⊙.

Proof.—A D is a tangent to the ⊙ since A D is ⊥ to radius O P.

Draw O Q, O R, O S ⊥ to A B, B C, C D.

The diags. A C, B D bisect the ∠s at A, B, C and D.

O is on the bisector of A ∴ ⊥ O P on A D $=$ ⊥ O Q on A B.

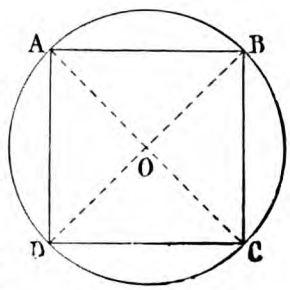
O is on the bisector of B ∴ ⊥ O Q on A B $=$ ⊥ O R on B C.

Thus ⊥s O P, O Q, O R, O S are equal.

∴ ⊙ passes through P, Q, R and S.

Also each side touches ⊙ ∵ tangent is ⊥ to radius (Prop. 74).

Proposition 84.—Problem



To describe a circle about a given square.

Let A B C D be the given sq.

Join A C, B D cutting at O.

With centre O and radius O A describe a ⊙.

This is the required ⊙.

Proof.—The diags. of a □ bisect one another (Prop. 31, cor. 1).

The diags. of a sq. are equal.

∴ O A $=$ O B $=$ O C $=$ O D.

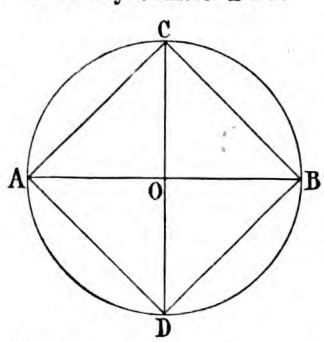
∴ ⊙ described with centre O and radius O A will pass through B, C and D.

Proposition 85.—Problem

To inscribe a square in a given circle.

Let the given circle have centre O.

Draw any diameter A O B.



Draw a diameter C O D ⊥ to A O B.

Join A C, C B, B D, D A.

Then A C B D is the required sq.

Proof.—Each ∠ in A C B D is a rt. ∠ ∵ it is an ∠ in a semicircle (Prop. 70).

In △s A O C, B O C

A O $=$ B O (radii)

O C is common

included ∠ A O C $=$ included ∠ B O C

∴ △ A O C $=$ △ B O C (Prop. 5).

∴ A C $=$ B C.

Similarly, B C $=$ B D and B D $=$ D A

∴ A C B D is a square.

Proposition 86.—Problem

To describe a square about a given circle.

Let the given ⊙ have centre O.

Draw any diameter A O B.

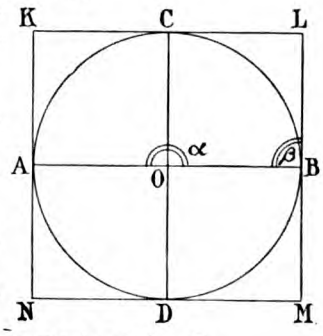
Draw diameter C O D ⊥ to A O B.

Through A and B draw K N and L M ∥ to C D (Prop. 29).

* For definition see page 432.

Through C and D draw K L and N M ∥ to A B (Prop. 29).

K L M N is the required sq.



Proof.—O L is a □. α is a rt. ∠. O B = O C (radii).

∴ O L is a sq.

Similarly O K, O M, O N are squares.

∴ K L M N is a square.

Again β is a rt. ∠. (∵ O L is a sq.).

∴ L M touches ⊙.

Similarly, M N, N K, K L touch the ⊙.

∴ K L M N is required sq.

Proposition 87.—Problem

To inscribe a circle in a given triangle.

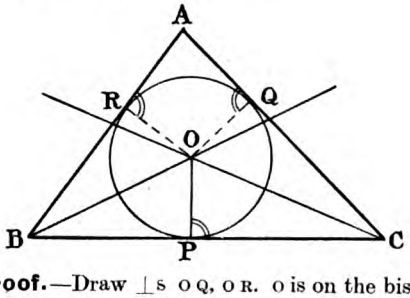
Let A B C be the given △.

Bisect ∠s at B and C by str. lines intersecting at O (Prop. 19).

From O draw O P ⊥ to B C.

Describe a ⊙ with centre O and radius O P

This is the required ⊙.



Proof.—Draw ⊥s O Q, O R. O is on the bisector of ∠ B ∴ ⊥ O P on B C = ⊥ O R on A B

O is on the bisector of ∠ C ∴ ⊥ O P on B C = ⊥ O Q on A C.

∴ the three ⊥s O P, O Q, O R are equal

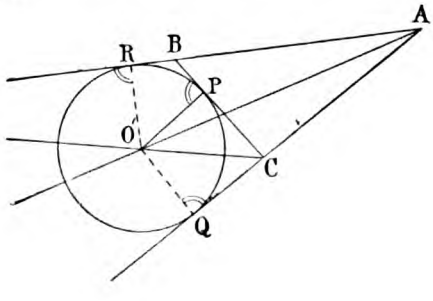
∴ ⊙ with centre O passes through P, Q and R.

Also each side touches ⊙ ∵ tangent ⊥ to radius (Prop. 74).

This ⊙ is called the **inscribed ⊙ or incircle,** and its centre is called the **incentre.**

Proposition 88.—Problem

To draw a circle outside a triangle, which touches one side of the triangle and the other two sides produced.



Let A B C be the given △.

Bisect the internal ∠ at A and the external ∠ at C by str. lines which intersect at O′ (Prop. 19).

Draw O′ P ⊥ to B C.

To the centre O′ and radius O′ P describe a ⊙.

This is the required ⊙.

Proof.—This is similar to the proof of Prop. 87, and is left to the student as an exercise.

This circle is called the **escribed ⊙** or excircle, and its centre is called the **excentre.**

Proposition 89.—Problem

On a given straight line to construct a segment of a circle containing an angle equal to a given angle.

Let A B be the given str. line and α the given ∠.

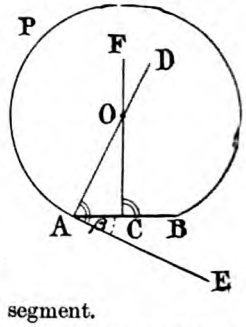
At pt. A in str. line B A make ∠ β = α (Prop. 18).

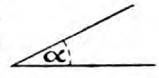
At pt. A in str. line E A draw A D ⊥ to A E (Prop. 21).

Bisect A B at C (Prop. 20).

At C draw a ⊥ to A B cutting A D at O (Prop. 21).

With centre O and radius O A describe a segment of a ⊙ on the side remote from A E; this is the reqd. segment.





Proof.—All pts. on the ⊥ C F are equidistant from A and B.

∴ the ⊙ will pass through B.

A E is tangent to the ⊙ at A (∵ A E is ⊥ to radius A O) (Prop. 74).

Also A B is a chord of the ⊙.

∴ β = ∠ in segment A P B.

∴ ∠ in segment A P B = α.

Definition.—A common tangent to two circles is called **direct** or **external** if its points of contact are on the same side of the line joining the centres, and is called **transverse** or internal if its points of contact are on opposite sides of this line.

Exercise 17

(1) Two unequal circles intersect in A B; a line is drawn through A meeting one circle again in P and the other in Q, and a parallel line is drawn through B meeting the first circle again in R and the second in S. Prove that P R is parallel to Q S.

(2) Show that if a straight line cuts two concentric circles, one in A and B; the other in C and D, then A C = D B; show also that the middle points of A C, B D are equidistant from the centre of the circles.

(3) Through two fixed points A, B on the circumference of a circle, any pair of parallel lines are drawn, cutting the circle in points P, Q. Prove that the line P Q in all its positions touches a second circle concentric with the given circle. Draw a diagram and construct the second circle.

(4) Draw a circle to pass through a given point and touch a given straight line at a given point.

(5) Two segments of circles have their bases A B, B C in the same straight line A B C; they lie on opposite sides of these bases, and the angle in one segment is the same as the angle in the other. Show that the arcs have a common tangent at B, and that the tangents at A and C are parallel. M. A. L.

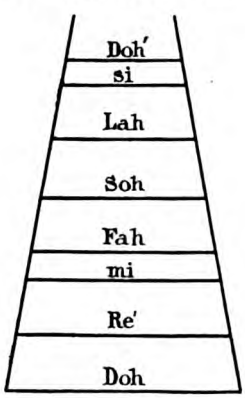
Continued from page 369.

ART AND MUSIC:

***Contributors*:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).**

MUSIC.—IV

NEARLY every grown-up person, and also almost every intelligent boy and girl in their "teens," not afflicted with any degree of deafness, can sing with fair accuracy of intonation the common scale of eight notes, starting from any sound suitable to the compass of their voices as a Doh, and singing upwards to the octave doh′.



The Common Scale

It seems quite a natural thing to do. Yet the scale as we know it does not exist in Nature. It is an artificial thing, to which generations of mankind have accustomed themselves, as they have to the harmony of choirs, organs, orchestras, pianos, etc., which we now feel to be so glorious and grand. Music, indeed, had to be "found out," captured, and mastered, as Ventosus, the Wind Giant in the fairy tale, was mastered and harnessed.

The parallel is not fantastic. The Ogres and the Trolls of Scandinavian folklore were no more formidable than such early monsters of sound as the organ at Winchester, in the time of good Bishop Alphege, with its 400 pipes, seventy sweating blowers, and its torrent of thunderous tone that is said to have deafened the city to all other sounds.

And we can carry the simile a little farther with propriety. The moonbeam fairies and the tricksy sprites, whose lantern is the will-o'-the-wisp, and the delicate elves who revel in the chaste ballroom of a bluebell, are only the representatives in Oberon's kingdom of the gossamer harmonics that dance on the E string of the violin of the Kubelik or Elman.

Egyptian Lutes and Harps

The historic distance, however, between the technique of the two players on the Winchester organ, thumping their big slabs of keys, and the highest modern instrumental technique, is not so great as that which is bridged by the years behind Winchester to the time when melody first became an Art.

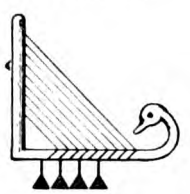


Fig. 1.

Fig. 2.

1.—Ancient Egyptian harp, showing tassels used for tuning the strings. 2.—Egyptian harp, from a fresco in a tomb opened at Thebes. Tuned by pegs. It will be noticed that the harp has no front pillar.

We have, indeed, no record how or where Music began. We have to acknowledge a certain indebtedness to the Greeks, and probably also to other peoples like the Egyptians and Assyrians. But we are left to infer what the music of the Egyptians was like from the representations of their instruments, which have been found on frescoes, in tombs, and on the walls of ruins. Sometimes one finds a forlorn piece of an old instrument.

That they had some wonderful instruments

of the harp and lute kind, elegant in form and elaborate in decoration, is shown by the treasures in the British Museum and in other national storehouses. (Figs. 1 and 2.)

That their music included a regular scale of notes is shown by the arrangements made for tuning the harps, etc., which was done either by twisting a peg or by pulling the strings tighter by means of the tasselled end which was wrapped round a bar.

The long necks of the ancient lutes, too, gave a keyboard on which a large number of notes could be produced. But pictures of instruments afford no guide to their scale of notes, and we have no Egyptian written records.

In the case of the Greeks we are historically better equipped, and it was doubtless from them that the south of Europe, and then Britain, received a certain amount of musical knowledge, including the scale of intervals which was in use till harmony demanded a wider field of expression.

The Mathematics of Music

The investigations of musical antiquarians have not shown any real continuity between modern European and Greek music. They have rather succeeded in showing what we should call a European renaissance, followed by progress on new lines.

For example, the Greek method of harmony consisted in accompanying a melody with notes above it. In modern music, the melody is supported on a foundation of harmony; and we are so accustomed to this that we can hardly think of melody accompanied otherwise. But the Greek system was no doubt suitable to their instruments—flutes and strings, sounding notes about the pitch of those of the first two octaves of the right hand half of the piano, and then only playing in thirds, fourths, or fifths, for which they evolved definite rules.

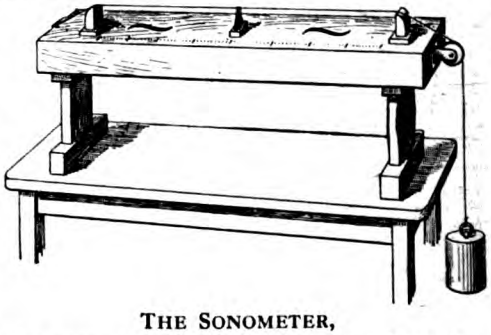
Up to a certain time in Greek music the memory and taste of singers and players were untrammelled, so far as we know, by any fixed scale of intervals; and it seems clear that, until some means of fixing the pitch of musical intervals had been invented, vocal music must have been a somewhat haphazard accomplishment. In process of time, however, and probably through the experiments of players on stringed instruments, it was discovered that there was a peculiar connection between concordant intervals—that the notes of such chords (Figs. 3 and 4), sounding so pleasantly, had, by the length of string required to sound them, a definite mathematical relationship to each other.

Fig. 3.

Fig. 4.

Here was a discovery which set the philosophers to work, and the mathematics of music were investigated with zest. The practical value of most of what the philosophers did equals to us the value of the work of the professors of the University of Zaputa, that Gulliver discovered; but the Greeks certainly fixed the notes of the scale, and passed them on to us. And by means of a sonometer, we can reproduce and see how this was done.

The sonometer consists of a wooden case or sounding-box, supported on a table. Over the sounding-board is stretched a piano-string kept taut by the weight which runs over the pulley. A movable bridge can be placed at any desired point between the fixed bridges. The length of the string should be about 6 feet, and then the effect of extra tension in causing rapidity of vibrations can be experimented with by increasing the amount of the weight.



THE SONOMETER,
by means of which the notes of a scale can be measured.

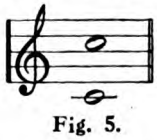


Fig. 5.

Now for our first trial. If the whole length of the chord between the two fixed bridges, vibrating, produces the fundamental note C, then if the movable bridge is shifted, according to accurate measurement, half the length of the string will sound the octave of the fundamental C (Fig. 5).

Shifting the bridge a little, we find that two-thirds of the chord will produce G,

three-quarters of the length sounds F, three-fifths makes A, and four-fifths E. If we take eight-ninths of the string we get the note D, and eight-fifteenths gives us B, the next note to octave C′, which, as we have seen, is obtained from eight-sixteenths, or one-half.

Greek Measures

This was the way, we know, in which the Greeks measured out their intervals; and they gave the notes alphabetical signs, just as we do. It was a very remarkable point to have reached, and made it possible for Greek musicians to keep a permanent record of tunes. Some of these have actually survived to the present day.

A modern musician would be struck with the smallness of the range of these tunes. He would find that the compass is much more that of a speaking voice than of a singing voice. Modern singing is, of course, at a much higher pitch than that of speech, and to the sensitive Greek ear would no doubt sound harsh and strident. The combination of different sounds into a harmony was not seriously undertaken by the Greeks. They were, however, accustomed to sing, in high and low voices, in octaves. They were accompanied by instruments of which the strings were divided in such a way as to produce notes suitable for octave singing.

With regard to the effect of increasing the weight pulling on the string, we find we can get the octave by increasing the amount of tension four times—that is to say, if a weight of 28 lb. causes the string to sound C, we have to hang on a hundredweight (112 lb.) to get the octave C, and we should quadruple that weight to get another octave, if the string would stand the tension.

Modern Instruments

The laws of this interesting side of the study of undulations have been most carefully investigated by the great makers of pianofortes; and the manner in which the frames of the best modern instruments are constructed to stand the immense strain of the many tightened wires is a marvel of scientific ingenuity.

In due course we will investigate the philosophic scale, and show by its means the intervals which we sound on our pianos and on other keyed instruments, and which singers and violinists imitate with such beautiful accuracy and fluency. H. G.

From the painting by Sir David Wilkie, R.A.

THE BLIND FIDDLER.

Continued from page 376.

BUSINESS AND COMMERCE:

***Contributors*:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).**

COMMERCIAL TRAINING.—XIV

Goods received into this country—i.e. imported—may be divided into three main classes :—

(1) Those liable to Customs duty ;
(2) Those that may be entered free ; and
(3) Those that are landed and stored for a limited period before being re-exported to some other country.

Although duty has eventually to be paid upon all dutiable articles, it would obviously entail the locking-up of an immense amount of capital if these duties were exacted the moment goods were landed. Tobacco, for example, often does not reach the consumer for many months after its arrival ; and, if the tobacco manufacturer had to pay the duty immediately a consignment were landed his capital would lie idle for a very considerable period. In the case of wines and spirits the period might well be far longer.

"In Bond"

To obviate this difficulty there is in vogue a system of Bonded Warehouses, owned by dock companies, commercial companies, or even by private individuals, but always under the authority of the Customs officials. In the vaults, or storage rooms of the warehouses, are placed such dutiable goods as come by ship, but which are not likely for some time to reach the consumer. So long as the goods remain in a bonded warehouse they are said to be "in bond," and the amount of duty payable upon them need not be settled until such time as they are removed.

Every operation in the movement of a ship's cargo—whether it be a small parcel or a thousand-ton lot—is carried out by means of documents or forms ; and in the case of taking goods from a ship to a bonded warehouse, a paper known as an "Entry for Warehousing" must be employed. As for the charges payable, they are, in the case of tea and one or two other commodities, based upon the weight of the goods at the time of landing. Tobacco, however, loses in weight materially by the drying of its fibres whilst in warehouse ; and spirits and wines lose a little by evaporation, according to the length of time they are stored. In these latter cases, therefore, the amount of duty payable is charged upon the condition of the goods when they leave the warehouse, and not at their arrival at the dockside.

Bills of Lading

The bonded warehouses only take a portion of the dutiable goods that are landed in this country. The remainder go either direct into a manufactory or else to the consumer ; and in these cases the duty must be paid at once.

As a matter of fact, no goods of either class may be removed without a warrant of some kind. There must be a warrant for the bonded warehouse, a warrant for home use, or a warrant for re-exportation. This latter document refers to dutiable goods received from abroad, landed from one ship, but placed direct in another for transhipment to some other foreign place. Thus, to execute an order, it might be necessary to obtain wines from France for transmission to Australia, in which instance no duty would be payable in this country.

So far as the process of importing goods is concerned, the document that forms the basis of every transaction is the Bill of Lading. There are different bills of lading for steamers and sailing ships ; and, in commercial correspondence, the term Bill of Lading is often contracted into B/L.

Imagine you are to receive some goods from Bombay. The person, or firm, with whom you are dealing in India, prepares and packs the goods, and dispatches them to a certain steamer. For the consignment three bills of lading are made out, which are

termed a " set." One of these is retained by the consignor, or party dispatching the goods ; the second is handed to and retained by the captain or master of the vessel ; the third is sent by post to the consignee, and is preferably sent a week in advance of the steamer, so that it may arrive before the goods and give the person who is to receive them an opportunity to arrange for their handling and prompt disposal.

When you are to receive goods from abroad, therefore, your first intimation will be the receipt by post of a B/L, which shows precisely what you are to receive, the name of the ship, master's name, how the goods are packed and numbered, and the particular marks that appear on the bags, cases, or bales, together with the cost of freight or carriage, and other particulars.

The bill of lading you receive will be signed by the master of the vessel ; and this particular document in this country must bear a sixpenny stamp before it can be put into execution. In most cases the words " weight and contents unknown " appear at the foot of the bill, for the protection of the captain of the ship, but in certain cases these matters are checked before the ship sails. In this instance the particular words are deleted by a stroke of the pen, and the document becomes a " clean " bill of lading.

Marine Insurance

Risks of war, sea, fire, and accidents to the ship, not caused by direct negligence, are no part of the responsibilities of the master or shipowners, and these risks are covered by a Marine Insurance Policy—a matter that will be fully explained later.

A bill of lading is a transferable document, freely negotiable. Thus, the consignees may dispose of the goods in transit, and the purchaser may with the original B/L claim them from the ship. In business dealings it often happens that the space for the name of a consignee is left blank in the bill of lading, to be filled up on the delivery of the goods.

After the ship's arrival, the bill of lading should be presented to the ship's broker, who has charge of the clearing of the ship, and who attends to the receipts and payments of the ship in the particular port.

The ship's broker examines the bill of lading, signs it, and, if necessary, notes upon it the exact amount of the freightage or carriage payable on the goods the bill represents.

The consignee must then bring the matter before the Customs officials, and must take out a warrant, of which an official copy is kept, according to the nature of the goods themselves. If they are goods that may be entered free of duty, the consignee passes a free entry ; if they are liable to duty, the consignee must either pay the duty or arrange for the goods to be placed in a bonded warehouse, filling up the forms prescribed for each case ; if, however, the goods are dutiable, but are to be transhipped to some foreign port, the forms that meet this case must be filled in. A. B.

CHOOSING A CAREER.—XV

The Municipal Services.—Up and down the country, there is a most efficient form of local government, with almost innumerable councils. First, we have the Parish Council of small villages or hamlets ; then the Rural District Council ; then the Urban District Council ; the (Non-County) Borough Council ; the County Borough Council (including cities) ; the Metropolitan Borough Council ; and the County Council.

The members of these councils or corporations are local men and women who have been elected by their fellow-townspeople, but their executive is composed of officials of many degrees who collectively form the Local Government or Municipal Officers of the country, totalling altogether at least 60,000 workers of both sexes.

In a way, this section of employment may be referred to as a type of local Civil Service ; and yet, from the workers' point of view, it possesses none of the hide-bound traditions of Government employ ; and there is practically no standardisation of salaries at present, of method of entry, or even of superannuation ; though the question of pension is likely soon to be settled on a national basis.

It should be clearly understood that a Local Government Officer is appointed by a Council at a definite salary paid monthly ; and must not be confused with a Council workman, be he navvy, scavenger, tramway-conductor or lamplighter, who is appointed by the head of his department and may be discharged by the same authority, receiving his wages weekly.

We have at the head the **Town Clerks.** They are statutory officers ; that is to say, they are appointed under the Statute or Act of Parliament.

An annual salary of £1,000 is quite commonly met with among Town Clerks, and there are a few at £,1500, £2,000 and even £2,500. At the same time, there are on smaller councils laymen Town Clerks at £130

a year and solicitor Town Clerks giving only part of their time at less than £100.

Every Town Clerk has to be well versed in the law as it applies to local government matters; and most of them are qualified solicitors. At the same time, there are many laymen holding most important town clerkships; and with some councils there is a separate solicitors' department.

From the Town Clerk, we come to the heads of the various executive departments; which vary according to the size and development of the particular town. The following however, forms a comprehensive list :—

The Solicitors' or Legal Department, which deals with Parliamentary and other legal business.

The Treasurer's and Accounts Department, attending to general finance, receipts and expenditure, rates and taxes; though, with some councils, there is a separate rate department.

Engineers' and Surveyors' Department, for the care of roads, buildings, construction works and so on.

Trade Departments, which apply to those councils that carry on municipal trading concerns — gas, water, electric light, tramways, etc.

The Medical Officer of Health's Department, in which may come two or more Assistant Officers, inspectors of nuisances, school medical officers, school inspectors (not for the purposes of education, but for health and sanitary reasons).

Public Baths, Wash-houses, etc.

Libraries, Museums and Art Galleries.

Parks, Open Spaces and Municipal Cemeteries.

Analyst's Department; this officer may be on whole or part time, and the office may include a bacteriologist.

Weights and Measures Department.

Fire Brigade Department; executive.

Sewage Department.

Scavenging Department; a separate office or section with many of the councils.

The Director of Education's Department; which may include the care of technical schools. In this department there may be an inspector of schools, apart from the medical inspector, gymnastic instructors, and other officers.

Docks and Harbours Department—many of our largest docks and harbours are municipally owned and managed.

And it may be taken that practically every one of these departments gives employment to one or more **Junior Clerks**; a class that forms the chief recruiting section and the backbone of the service. These clerks, entering at 17 or 18 years of age, may be said to have the entire local government service before them; and it is a fact that several of our most highly-placed Town Clerks and other leading officers have actually commenced their careers as junior clerks.

The beginner having got his foot upon the ladder in one or other of the departments, can then, according to his natural inclination, bring about such transfer as may be necessary eventually to place him in the department for which he is best suited.

In practically every department, however, there will be minor office duties to be attended to; typewriting, in some instances shorthand, indexing, précis-writing, the compiling of reports and so on. As the career of the worker opens out he may expect to leave these minor but none the less important routine tasks behind him and to face the more technical features of his calling.

Thus, a young man in the Town Clerk's Department will begin to come into closer contact with legal matters, and he will probably wish to become a qualified solicitor. If this should be the case, it may happen that the Town Clerk himself is a solicitor; or, if he is a layman, that there is an Assistant Solicitor, or even two or three of these officers; in which event the young clerk may probably arrange to become articled to one of these legal practitioners.

At all events, this custom largely pertains in the Local Government service; though naturally a junior could not expect to receive his articles without being prepared to forfeit at least some of his salary besides a goodly proportion of his leisure to the purpose of private study.

Even in this direction there is no standardisation; and each council is more or less a law unto itself in the matter. Much, however, depends, as is the case in all walks of life, upon the personality and persevering ability of the junior himself.

Yet the fact remains that a youngster of ordinary secondary school education can, by pluck and effort, actually become a qualified solicitor at the sacrifice of no more than a portion of his salary and a good deal of his spare time.

The prospects of juniors in the treasurer's and other departments are also not without promise. These we will deal with next.

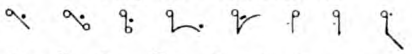
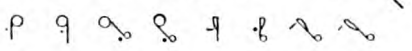
A. C. M.

SHORTHAND.—IX

Key to Exercise 34

1. spree, sober, stress, stresses, stressed, stroke, scrap, scribble.
2. sweeper, sweep, sweeter, sweet, swagger, swag, switch, switcher.
3. stopper, stop, stouter, stout, stag, stagger, stitcher, stitch.
4. saddle, safer, civility, decipher, explode, distresses, discloses, steeple.
5. *The principle of-the liberty of-the subject was-the* theme *of-the* address *of-our Principal.*
6. *We remember-the* glassware business, *the number of-which-you*-refer *to, and-it-was* sold *at its true* value.
7. *Our Member and-his* wife *care for-the* suffering among-*the* poor *of-the* constituency.
8. *The Christian doctor* wrote *a* volume *on* "*The Truths of Christianity.*"

Key to Exercise 35

1. 
2. 
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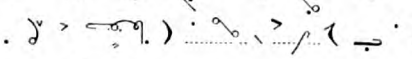
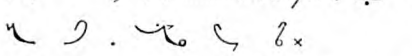
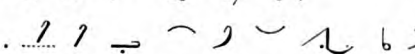
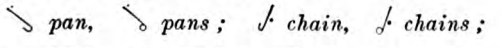
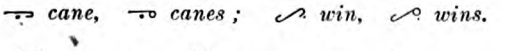
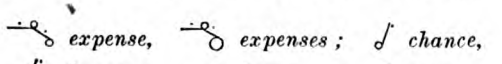
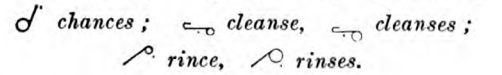
4. 
5. 
6. 
7.
8.

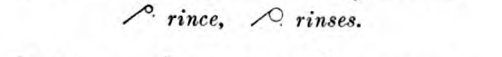
Circles and Loops to Final Hooks.—The circles *s* and *ses* and the loops *st* and *str* are added to the hook *n* attached to a straight stroke by writing the circle or loop on the same side as the hook; thus—

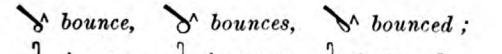

pan, pans; chain, chains;

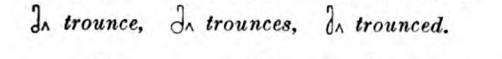

cane, canes; win, wins.

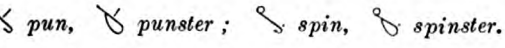

expense, expenses; chance,


chances; cleanse, cleanses;

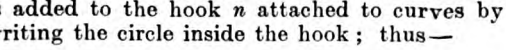

rince, rinses.

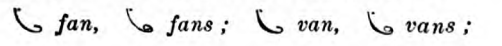

bounce, bounces, bounced;


trounce, trounces, trounced.


pun, punster; spin, spinster.

The small circle, representing the sound of *z*, is added to the hook *n* attached to curves by writing the circle inside the hook; thus—


fan, fans; van, vans;

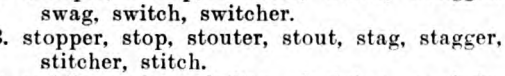

throne, thrones; shine, shines;

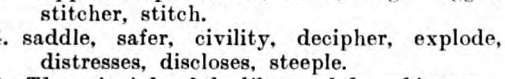
men, men's; noun, nouns;

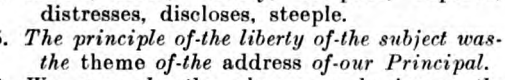
refrain, refrains; sermon,

sermons.

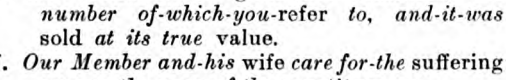
Stroke *n* and circle *s* are written for the light sound of *ns* following a curve; thus—

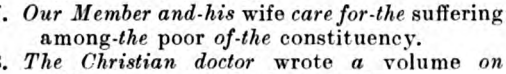

flounce, allowance,

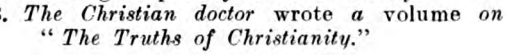

prominence, excellence,


science, immense.

The following groups should be carefully noted—


pronounce, pronounces,


pronounced, pronouncing,


pronouncer; romance,

romances, romanced,

romancing, romancer.

The circle *s* is added to hook *f* or *v* by writing the circle inside the hook; thus—

serve, serves; weave, weaves;

pave, paves; preserve, preserves;

cave, caves; cliff, cliffs.

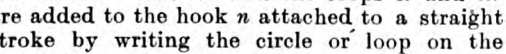
When *ns* or *nz* occur medially, both letters must be shown; thus—

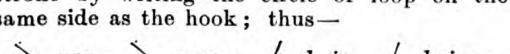
transit, densely, immensely,

offensive, Chancery, lancer;

lonesome, ransom, winsome.

Trans-.—To write stroke *n* for this syllable would give an awkward joining in many instances, and so the *n* is omitted; thus—


transpire, transpose, transfer,


translative.

Exercise 36

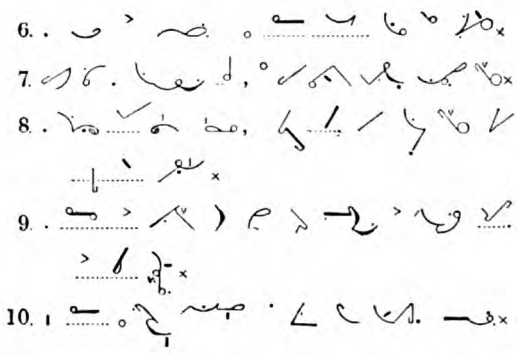
GRAMMALOGUES

one; opinion; signify-ied, significant;

significance; out of; which have;

at once.

1.
2.
3.
4.
5.

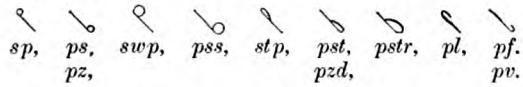


Key to Exercise 36

1. pan, pans, bun, buns, join, joins, skin, skins, siren, sirens.
2. appliance, appliances, trance, trances, dunce, dunces, sixpence, sixpences, remittance, remittances.
3. instance, instances, instanced, enhance, enhances, enhanced, prance, prances, pranced, spinster.
4. assigns, lemons, thrones, gallons, havens, essence, alliance, silence, excellence.
5. tariffs, derives, observes, motives, natives, transpires, cancer, ransoms.
6. *The opinion of-the* minister *is significant in-the* face *of-his* assurances.
7. *We-shall* sell *the* fencing *at-once, as we* hope *to*-receive enhanced prices.
8. *The* remains *of-our* summer stocks, *which-have-been large, are* fetching prices *which-are out-of all* reason.
9. *The significance of-the* reply *was* lost *upon-the* gathering *of-the* officials *of-one of-the largest* societies.
10. *He signified his* approval *and*-enclosed *a* cheque *for* fourteen guineas.

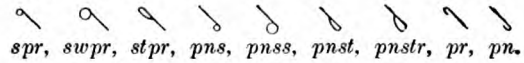
Revision of Initial and Final Circles, Loops and Hooks.—This lesson offers a favourable opportunity for the revision of the various circles, loops, and hooks that have been explained in the nine lessons. There are, however, two expressions which the student should use in this revision—Left Motion and Right Motion. Motion, as used in shorthand, is circular movement; therefore, the circular movement involved in the formation of circle *s* is called the *left motion;* the circular motion involved in the writing of circle *ns* is called the *right motion.*

Circles, Loops, and Hooks written with the Left Motion—



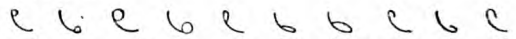
sp, ps, swp, pss, stp, pst, pstr, pl, pf. pz, pzd, pv.

Circles, Loops, and Hooks written with the Right Motion—



spr, swpr, stpr, pns, pnss, pnst, pnstr, pr, pn.

Circles, Loops, and Hooks written inside curves—



sf, fs, swf, fss, stf, fst, fster, fr, fn, fl. fz, fzd,

Circles written inside hooks—

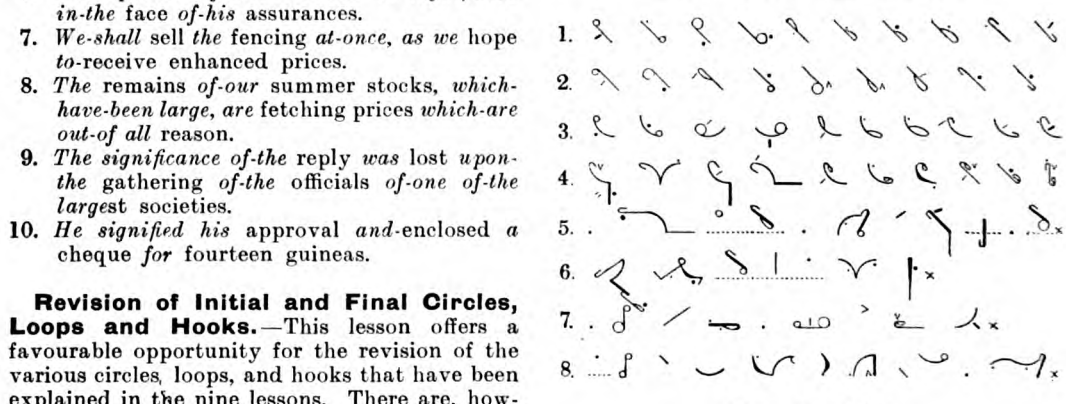
sfr, fnz, sfl, spl, nfs.

Again, we would urge upon the student the importance of frequent revision, not only of the various circles, loops, and hooks, but also of the grammalogues. Something like 60 per cent. of the words used in ordinary speech are to be found in the list of the grammalogues, and it therefore behoves the student to know the grammalogues perfectly. They should be known so well that, without the slightest hesitation, any one of them can be written down immediately it is heard.

Exercise 37

GRAMMALOGUES

circumstance; circumstances; balance, balances, balanced.



Exercise 38

GRAMMALOGUES

suggestion; suggestive; deliverance; who have.

1. sup, pace, sweet, tosses, stop, post, poster, play, pave.
2. stray, sweeter, stutter, pence, dances, danced, Dunster, pry, pine.
3. sieve, voice, swell, losses, stain, nest, master, ether, men, flow.
4. suffer, vines, settle, drives, civilly, fled, flock, frail.
5. *The suggestion of-the* girl led *to-the deliverance of-the people.*
6. *Any who-have a suggestive* title *for-the* book *should* write *us.*

Photo: Sir H. H. Johnston.

A HAMITE

belonging to that race of men, dark-skinned but mainly white in type and culture, whose migration from Western Asia across Northern Africa has raised problems of immense interest and importance to anthropologists. Cf. the Hamite shown on p. 278.

Continued from page 384.

ENGLISH LANGUAGE AND LITERATURE:

Contributors:—ENGLISH LANGUAGE (W. A. Craigie, M.A., LL.D.; E. W. Edmunds, M.A.). ENGLISH LITERATURE (John Derry, J.P.). PHILOSOPHY (E. H. Tripp, Ph.D.). POLITICAL ECONOMY (J. W. Urwin). ETHICS (W. H. Koebel). PUBLIC SPEAKING (J. W. Urwin).

DRAMATISTS OF THE RESTORATION

THE period of the Civil War and the Commonwealth produced no great literature. All that is best in it, such as the work of Milton, Bunyan, and some minor poets, comes to us as a delayed inheritance from the great Elizabethan literary movement.

The Restoration brought profound changes, mostly for the worse in poetry and the drama, but not in prose. The impression of continued decline in our literature is, however, modified, in some degree, by the fact that one writer, John Dryden, standing forth conspicuously, demands, by his vigour and mental power, a large measure of respect.

The Restoration, and the events which immediately preceded and immediately followed it, gave French literary influences unchallenged predominance over English writers. Choice of subjects, method and spirit of treatment, and style in expression were alike affected. Although France had not produced any literature comparable in exalted genius with that of England, her national writings, whether in prose or verse, were far better "ordered" than ours.

French Influences

The freedom and enthusiasm which fired the Elizabethan drama were regarded by the French as wild and rude. Restraint in French poetry had arisen with Malherbe, who was contemporary with Shakespeare, and an approximation to a standard of prose style had already been accepted on the model of the elder Balzac, who was about twenty years senior to Milton. The French Academy of Letters preceded by nearly a generation the British Royal Society, founded partly in imitation of it, and pledged from the first to "reject all amplifications, digressions, and swellings of style." French taste found satisfaction in the revival of the classic drama, so far as construction was concerned, with a style that illustrated the national love of conciseness, lucidity, and balance. The French drama tended to represent either high-flown romance in tragedy, or the outward manners and social conventions of the age in comedy.

The First Actress

While these influences were moulding French literature, as it has always been largely moulded, through the stage, the English stage was deserted. By 1648 all the English theatres were closed, the companies of actors dispersed, and during the next ten years the traditions of the Elizabethan stage were to a large extent lost. When, therefore, Charles II., himself half French, returned from France to reign in England, accompanied by a train of courtiers whose tastes had been formed by the French drama, and a new beginning was made with the drama in England, the inevitable tendency was to reshape the literature of the stage on French models.

Among the changes which came in the train of the Restoration may be noted the first appearance of women on the English stage. Hitherto women's parts had always been played by boys. In December, 1660, Killigrew's company of "Old" Actors staged *Othello* with the part of Desdemona played by a woman—an event which Pepys duly recorded in his diary. Under the date, January, 1661, he wrote that he had beheld women for the first time "come upon the stage."

The tendency to borrow from the French was accentuated by the slow growth of natural native drama. But in the meantime comedy was revived in France by the genius

of Molière, and the canons of generally-accepted literary criticism were set out in Boileau's *Art of Poetry*. Throughout this period, and later, while Molière, Boileau, La Fontaine, and Racine were dominating French literature, and "making form and style the perpetual object of their concern" (as a notable French critic expresses it), the eyes of English writers were fixed admiringly upon them. All these writers died before their contemporary Dryden, on whom they exercised a strongly formative power, which he, in turn, transmitted to his admirers. We see, then, how natural it was that Restoration literature should shape itself on French models.

Unfortunately it adopted an impure tone in which the French cavaliers of Charles's Court undoubtedly revelled, and the revived theatre pandered to their mood. Even Dryden, who was essentially a religious man, is not free from the reproach of having suited his style to the pleasure and taste of the Court. Unlike others, however, he publicly expressed his contrition when the purification of the stage became a question of national concern.

Restoration drama may be dismissed here with very summary notice.

Operatic Plays

Under the name of "opera," Sir William Davenant had made efforts to reintroduce the stage into England before the Restoration. His *Siege of Rhodes* was acted at one of the old theatres in 1656, and he received a licence for his spectacular semi-musical pieces in 1660. These were followed by mutilated reproductions of the Elizabethan plays. Shakespeare was eviscerated to suit the prevailing taste, and even *Paradise Lost* was turned into an opera. Modern comedy, of the French type, had its birth in England in Sir George Etherege's *Comical Revenge*, written in rhymed couplets and acted in 1664. In 1676 Etherege wrote *The Man of the Mode* in prose.

Thomas Otway, an actor, and a clergyman's son, educated at Winchester and Oxford, made a hit with a romance, *Don Carlos*, written in rhymed verse in 1676. Afterwards he adapted a tragedy from Racine, and a farce from Molière for Betterton, the actor. At the age of twenty-six he was serving in Flanders in the Duke of Monmouth's regiment. Early in 1680 his tragedy *The Orphan*, written in blank verse, proved a great success, which was more than repeated by his *Venice Preserved* in 1682. These powerful plays long held their place on the stage, a popular verdict supported by much competent criticism. Sir Walter Scott declared that Otway rivals Shakespeare in his scenes of passionate affection. Dissolute and impecunious, the poet died in an alehouse at the age of thirty-three. He is buried in St. Clement Danes Church in the Strand. With the exception of a single play by Dryden, Otway's tragedies are the best stage literature of the Restoration era.

William Wycherley, the shameless author of *The Country Wife* and *The Plain Dealer*, perhaps the most popular and certainly the most reprehensible of the Restoration dramatists, reappeared pathetically long after his playwright days, as an aged friend of the precocious Alexander Pope, who corrected the worthless poems of dotage, and then lampooned the writer.

Sir John Vanbrugh, the architect who built Blenheim House, dashed off some comedies, hearty and coarse, in prose, the best known being *The Provoked Wife*.

William Congreve

William Congreve, though of Yorkshire birth, was educated at Kilkenny, where he sat on the same seat as Jonathan Swift, his father being an officer of the Irish garrison. Congreve was one of the few early authors who lived constantly in the sunshine. Before he was three-and-twenty he had scored a success with his play *The Old Bachelor*, a comedy that ill-deserved public favour. *The Double Dealer* followed in the same year (1693); and, later, *Love for Love* raised its author to the pinnacle of contemporary fame. A pompous tragedy, *The Mourning Bride*, was less successful.

In 1700, Congreve wrote *The Way of the World*, as he said, to please himself. It did not at first please the public, but afterwards grew in popularity. Piqued by momentary failure, its author wrote no more for the stage, though he lived twenty-eight years longer, and remained, by universal acclamation, the central figure of the literary circle and a social celebrity.

George Farquhar, the first Irishman to make his mark in English literature, began his life's work at the age of eighteen as an actor in Dublin. Obtaining a commission in the army, he mixed military service with the writing of plays which now are more easily read than any stage writings of the period. The most popular of them, *The Constant Couple*, *The Recruiting Officer*, and *The Beaux' Stratagem* long held their place on the stage.

Though the dramatists already mentioned represented the influences of the Restoration, Wycherley's plays were written late in the Stuart period, and Vanbrugh's and Congreve's after the Revolution of 1688, when the country generally had recovered from the lapse into licence which widely, but not so widely as the drama indicated, marked the return of Charles II., and public opinion at large began actively to resent the appallingly low tone of the theatre. This revulsion was concentrated, powerfully though quaintly, in Jeremy Collier's *Short View of the Immorality of the English Stage*, published in 1698.

Collier was a High Church clergyman, afterwards a bishop, who had suffered imprisonment for his devotion to the Stuart cause, and as an ardent loyalist and Churchman was greatly respected by the decent section of the party to which nearly all the playwrights belonged. From such a source the protest came with redoubled effect and had a purifying influence. In it Wycherley, Congreve, Vanbrugh, and Dryden were specially attacked. Congreve and Vanbrugh issued feeble replies, but Dryden pleaded guilty, with the comment "it becomes me not to draw my pen in defence of a bad cause."

THE FIRST APPEARANCE OF WOMEN ON THE STAGE

can be traced to December, 1660, when Killigrew's company played *Othello*, the part of Desdemona being taken by a woman. Hitherto women's parts had always been played by boys.

Round John Dryden, the most prolific dramatist, the most virile poet, and the most adaptable prose writer of the Restoration period, controversy will always bicker. He spent his life in the midst of it, and bequeathed it to all who are interested in him. That controversy raged over politics, religion, morals, and literary methods; and, with a tantalising mutability, Dryden from time to time was on each side in each of these spheres of argument.

First he was a Parliamentarian and then a Royalist. First he was a Churchman and an assailant of Roman Catholicism, and then he was a Catholic himself. First he was a panderer to the lewd tone of the theatre of his day, and then he was a moralist. First he was a believer in the French use of rhyme in heroic plays, and in restricting and shackling poetry within the narrow bounds of the heroic rhyming couplet, which de-

manded that every thought should be completed in not more than two lines that must rhyme. And yet by far the best of his own tragical dramas, *All for Love*, was not written in rhyme, but in blank verse, contrary to the tenor of his own published opinions on the point; and by far the best of his poems, *Alexander's Feast*, was not

From the portrait by Sir G. Kneller. Photo: Emery Walker, Ltd.

WILLIAM CONGREVE (1670–1729).

written in rhymed couplets, but in a highly irregular measure.

It must be said for Dryden that whatever inconsistencies marred his life, in an age when trimming to please those in authority was a recognised accomplishment, his life grew in dignity as it lengthened, and when he died the features of his career that shake our respect for him had been left behind.

To this must be added that, both in verse and prose, Dryden brought into the literature of his country new elements of strength; that in his personal relations with men he was open-hearted, and generous in appreciation; that his spontaneous impulses of heart and mind were sound, and he had a powerful and logical intellect in alliance with considerable poetical susceptibility; but he was unusually accessible to new impressions, and had not the moral fibre and strength of character needed for steering an undeviating course through the temptations of an exceptionally changeful age.

He was born to a small landed inheritance in Northamptonshire, in 1631 his family and relatives being Parliamentarians. Before he left Westminster School for Cambridge he had already written poetry, after the affected manner of Cowley and Donne. Between the time when he left Cambridge and when he was seven-and-twenty little is known of him, but he possibly was acting as clerk to a cousin who was chamberlain to Oliver Cromwell, and when the Protector died he wrote *Heroic Stanzas* to his memory. That did not prevent him equally commemorating, two years later, in *Astræa Redux*, the return, and, in a *Panegyric*, the Coronation, of Charles II., adopting as his metre the rhymed couplet, which, later, he helped to perfect.

Dryden's genius flowered late. Between his thirty-second and thirty-fifth year, after his marriage to Lady Elizabeth Howard, he

From the portrait by Sir Peter Lely. Photo: Emery Walker, Ltd.

WILLIAM WYCHERLEY (1640 (?) –1716).

was busy writing plays, with growing success, the tragedies in rhyme, the best being *The Indian Emperor*. None of these plays adds to his literary fame.

The Great Fire of London and the Plague closed the theatres, and Dryden retired into the country, where he wrote his *Annus Mirabilis*—the Wonderful Year—describing the defeat, in 1666, of the Dutch fleet and the calamity of the Fire.

At the same time, while in retirement, the poet wrote his *Essay on Dramatic Poesy*, the first example in the English tongue of genuine literary criticism, written in a style that combined clearness and dignity with ease. Afterwards the poet prefaced all his important poems with prose introductions

which are invitations to the study of style, and these, with his *Essay on Heroic Plays* (published in 1672) and his *Discourse on Satire* (1693), give him the right to be regarded as "the father of English criticism."

The best tribute to the style and spirit of Dryden's prose writings is the universal admiration they have won, although many of the opinions he advanced are as universally rejected. His devotion to the "dramatic unities," to rhymed tragedy, and to the heroic couplet was in every direction restrictive, and tended to fetter literature and make it conventional. But Dryden was far more generous than his theories, and no one has appreciated more sincerely than he the poets whose writings could not be compressed within his rules. Shakespeare, Milton, Spenser, and Chaucer were his delight, in defiance of his own literary and artificial canons, and in his heart he knew that their inspiration far transcended the limits of French symmetry. But it was characteristic of him, that there should be this clashing between his instinctive tastes and his coldly reasoned opinions.

Between his thirty-fifth and fiftieth years Dryden continued to write and adapt comedies and tragedies. His most successful rhetorical tragedies were *The Conquest of Granada*, *Auren-Zebe*, and *All for Love*; but only the last—a compact, powerful, and thrilling presentation of the last stage in the story of Antony and Cleopatra, in which he discarded rhyme for blank verse—would have won for him a considerable place in the history of English literature.

At the age of thirty-nine he was appointed poet-laureate in succession to Davenant and also historiographer royal in succession to James Howell. His income from this time forward must have been substantial, but having three sons to educate, he was always comparatively poor.

In 1681, the poet, then being fifty, for the first time found his true vein, not as a writer for the stage, but as a political satirist. It was a time of fiercest semi-political, semi-religious turmoil. The nation at large distrusted James, the King's brother, who was heir to the throne, and was avowedly Catholic; and Shaftesbury and the Whig Party wished to see the Duke of Monmouth, who was an illegitimate son of Charles, and a Protestant, adopted as the royal heir. To this Charles was averse, and, in collusion with the King, Dryden wrote his first satire, *Absalom and Achitophel*, in which a somewhat parallel narrative to that of Absalom in the Bible was applied to leading national characters, to castigate the opponents of the King.

From the Kitcat Collection, Bayfordbury, Herts.

JOHN DRYDEN (1631–1700),
the most prolific dramatist, the most virile poet, and the most adaptable prose writer of the Restoration Period.

Usually the writings produced by the acute but passing controversies of any age die with the age that called them into existence. Dryden's controversial writings are the exception. They do not defend any principle of lasting value, and yet they retain a certain vitality by reason of their point and force, dexterity and martial ease.

The poet had another distinction. He could argue in verse fluently and gracefully. This he proceeded to show with characteristic contradictoriness. In his fifty-first year he published a poem, *Religio Laici* —the religion of a layman—in defence of the Church of England; and in his fifty-fifth year he published another poem, *The Hind and the Panther*, in which the innocent Hind was the Church of Rome and the spotted Panther the Church of England, for by this time he had become a Roman Catholic, like the King, for James was now on the throne.

Dryden's Translations

The next year, however (1688), witnessed the flight of James II., and the accession of his Protestant daughter Mary and her husband William of Orange. Dryden was now in a difficult position, from which he could only be extricated by an honourable fidelity. The Test Act debarred him from holding his office as poet-laureate, for, as a Catholic, he could not take the oath admitting to official service. He took the high road of honour and resigned his preferments.

Dryden now turned once more to the stage for the means of living, and re-attempted tragedy, comedy, and opera with declining success; but at last found, through the booksellers, for translations of the classics, supplemented by the re-telling in verse of stories from the earlier poets and romancers —Homer, Ovid, Boccaccio, and Chaucer— a better market than the theatre provided. His principal classical translations were from Virgil.

The poet's method of translation was to give a free rendering of the original, approaching a paraphrase, without troubling about textual exactness. This treatment was openly defended by him in his prefaces.

Long before the end of the seventeenth century Dryden had reached a position of unquestioned supremacy in contemporary literature. He was the great man of letters of his day, even more exclusively than Ben Jonson had been before him, or than Dr. Johnson was after him. Though his health became impaired by the gout, which at last killed him, his fluency and virility as a writer, whether in prose or verse, did not diminish with age, and *Alexander's Feast*—perhaps the most admired of his lighter poems— was written in his sixty-seventh year.

He died on May Day, 1700, at his house in Gerrard Street, and was buried in Westminster Abbey. A giant among the men of his day, he remains a permanent landmark in our literary history. J. D.

ENGLISH LANGUAGE.—IX

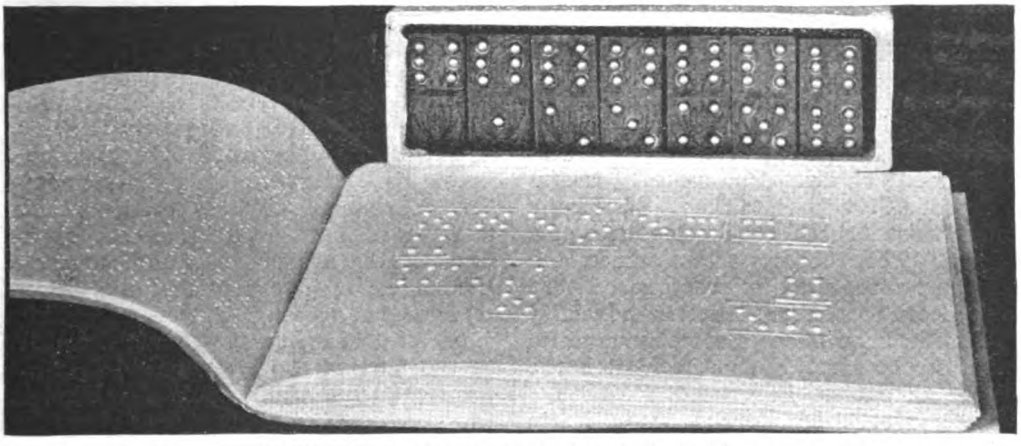
It has been said that "style is the man"; and it is true that a writer's personality is revealed in his style. An examination of a building will show the skill and quality of the worker, as well as the genius and thought of the architect; in composition, worker and architect are one: the designer works out his own designs, and he has the opportunity of unfolding the contents of his mind in such manner as his own special experience suggests. What he will make of his opportunity depends primarily upon the skill which he has acquired during his apprenticeship to the study of his language: at the same time he will achieve nothing that is distinctive unless he gives free play to the activities of his mind, and unless he reads widely and thoughtfully in the best authors.

To cultivate a style imitatively, from the study of any particular master of English, is not desirable and, indeed, is not possible. It is not difficult to catch his mannerisms or to parody his peculiarities, but the essence always escapes us. The attempt to imitate, say De Quincey or Ruskin, ends in empty bombast or airy floridity; few writers could sustain their success in such an attempt beyond a few lines.

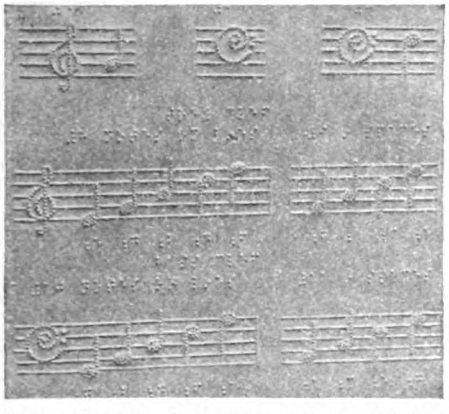
The Elusive Qualities of Style

Nevertheless the study of our first-rate prose-writers is invaluable, and, indeed, indispensable. It is important to discover for ourselves at first hand the secrets of their mastery. These cannot be inventoried in a catalogue of trade secrets; their basis is rooted inextricably in the writer's personality; they are a part of himself. Learn from all, but imitate none; keep the best literary company possible; follow fearlessly and sincerely the trail of your own thoughts: and style will take care of itself.

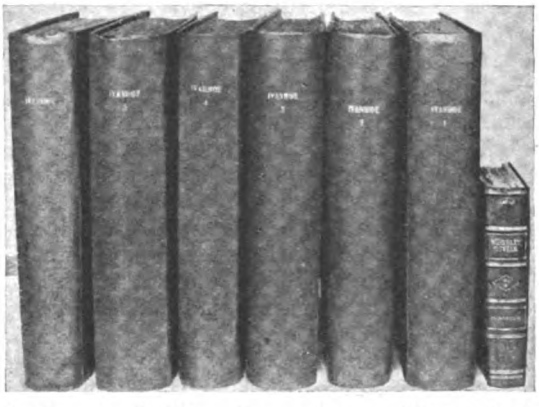
In spite of all this, however, certain elements of style can be cultivated, and can be acquired by any educated Englishman. The "high style," original and personal, with its idiosyncrasies of form and colour, is not appropriate for all occasions. There is a standard of English prose style, adapted to the pedestrian purposes of language, which has been developed during the past two centuries, and is well illustrated in our best journalism, in our periodical literature, in our best text-books, histories, biographies and the like. Dryden, Goldsmith, Hazlitt and modern writers like Sir Walter Besant or Andrew Lang may be regarded as favour-



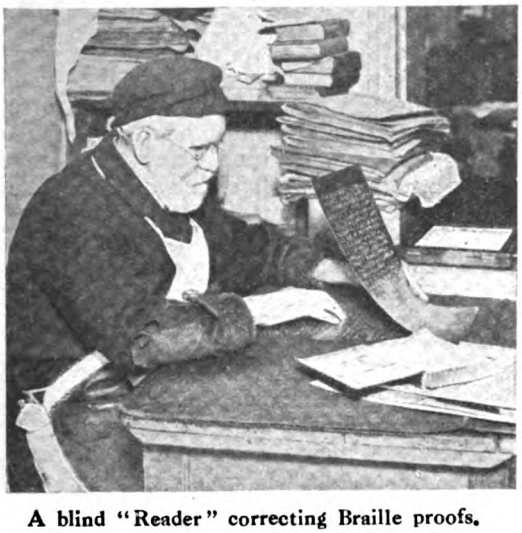
Braille Dominoes and the Braille Book of Games.



Some raised musical signs and the Braille equivalents.



Ivanhoe in Braille. An ordinary edition of the novel is shown on the right.



A blind "Reader" correcting Braille proofs.

A blind shorthand writer using her special machine.

HOW THE BLIND "SEE."

able practitioners of this straightforward standard of style.

Its qualities are lucidity, proportion, balance, ease; it is an exquisitely-made tool, applicable to every kind of work, alike to the needs of everyday, to the graceful musings of a Stevenson, to the polished irony of a Matthew Arnold, to the eloquence of a Newman. This tool may be obtained and its skilful use acquired by everyone. Every one can learn to express himself with lucidity and ease, in harmonious and not ungraceful sentences: he must do this first; it is the basis of all success in writing.

Whatever style be adopted, the ultimate criterion of success is its fitness for the purpose to which it is applied. The subject matter must contribute largely towards the decision of a suitable style.

Lucid Prose

English Literature is rich in prose masterpieces, wrought in every shade and variety of style. We have a large amount of dignified and permanent work in the plain and simple style that may be regarded as the standard English prose. From Dryden to Hume, from Hazlitt to Darwin, from Grote to Lord Morley, we see it applied to the manifold purposes of science and philosophy, history and criticism.

Such writers as these can be imitated in the essential features of their style; they show at once the simplicity and the complexity, the flexibility and the definiteness, the precision and the fullness of which an unadorned but lucid prose is capable.

Nevertheless, it is the variations that cause literature to satisfy, not the intellect merely, but the imagination also. Pleasure as well as—and sometimes more than—instruction is to be given; we do not always wish to teach or to convince, but to delight; we appeal to the taste as well as the intelligence, to the sense of beauty more than to the logical or moral faculties. Our prose-literature, on this higher and more difficult plane, is again rich in examples which show, more emphatically than the direct and straightforward prose of a Swift or a Huxley, the impress of the writer's personality.

The sonorous resonances of Milton's prose, the grave pedantries of Browne, the sly graces of Addison, the measured stateliness of Gibbon, the pathetic suggestiveness of Lamb, the sunset splendours of De Quincey, the rugged grandeur of Carlyle, the picturesque volubility of Ruskin—these are but a few of the symphonies that can be extracted from the gamut of English prose.

We can deduce no rules for the writing of such language; yet we can in an imperfect way perceive wherein it departs from the plain path of direct and merely lucid prose. It is a language enriched by congruous and becoming ornament; and the elements of this adornment may be considered briefly under four main headings; viz. (*a*) variations of the normal rules and structure of the language; (*b*) exceptional uses of words; (*c*) figures of speech; (*d*) rhythm and music.

(*a*) Most of our great writers are respectful to the laws of the language; but a single page of Carlyle will make it clear how much the peculiar tone of his prose depends upon the liberties he takes with the English tongue. But even in him it is not the essential, even though an important, feature; and the effect of such solecisms as the omission of valuable particles, unusual transpositions of words, archaic expressions, and the like is never profound.

(*b*) In the matter of the use of words we are on different ground. A good writer is aware of a force in words which is far beyond their dictionary definitions. There is an atmosphere, a vague suggestiveness, around many words which eludes all attempts to give it exact meaning; and the use of such words, beautiful either by association or in sound, enriches their context with indefinable graces and will often transform a passage of flat prose into arresting and memorable literature.

Figures of Speech

(*c*) Closely allied with this suggestive use of words is their figurative use. By a figure of speech we mean an expression which increases the vividness and justness of a thought by drawing attention to some unforeseen and unexpected resemblance or analogy. A word used figuratively conveys a fuller and more lively significance than a mere literal statement could. That this is so is acknowledged by the frequency with which our ordinary speech has become enriched with figurative words, now used in such a commonplace manner that the figurative sense is forgotten.

Figures of speech may be broadly classified into two divisions: the imaginative, appealing primarily to the understanding, and dependent upon the meanings of words; and the rhetorical, making their appeal rather to the senses, and dependent upon their sound.

All writers of prose who desire to write well are students of rhetoric, and employ the various devices of inversion, omission, climax

and the like which we class together as the rhetorical figures of speech. We cannot here go fully into these, but a few of the most familiar must be mentioned.

The effect of climax is well understood by all writers. It means the development of our ideas from small to greater progressively, until at the close we reach the most important point of thought and there end effectively. Less familiar, but equally potent in its place, is the anticlimax, in which the thought is kept for a time at a high level, and is then suddenly brought down to earth ; e.g.—

(i) His words were uttered with a fierce eloquence that filled us with high resolutions, elevated impulses, a fervent determination, and—the unmistakable odour of rum.

The rhetorical question is a favourite device of many writers and speakers. A statement is made in the form of a question, to which an obvious answer is implied ; e.g.—

(ii) Does anyone think that the Government has been sufficiently alert in this matter ? [meaning that no one thinks so].

The paradox is a statement which on the face of it is self-contradictory : it is effective by reason of its wit.

(iii) They have worked hard and done nothing.

The figures just mentioned appeal primarily to the intelligence ; but there are others whose first appeal is to the ear.

Alliteration is the repetition of the same sound in a series of words which are consecutive or practically so ; e.g.—

(iv) The silence of the soldiers was a significant sign of their surprise.

Metaphor and Simile

The first and most important of the imaginative figures of speech is the metaphor which is a simile or comparison, not made directly, but left for the mind to discover. In the simile proper, a comparison is made between two things which resemble one another in some one or more particulars ; and the word *like* or its equivalent is always expressed. When the likeness is not definitely expressed, but merely implied, we have a metaphor.

Many of the words in ordinary speech are used metaphorically. Thus, we recognise the metaphor when we write " He *grasped* what I said." When we speak of metaphors as an adjunct of style, we do not refer to those which have become everybody's property and are used unconsciously ; but to those which the writer employs consciously and individually.

When an inanimate object or abstraction is spoken of as though it were alive and real, we have personification, and when a personified idea is addressed as though it were present, the figure is called apostrophe ; e.g.—

(v) Can Honour's voice provoke the silent dust ?

(vi) Hail to thee, blithe Spirit !

A frequent figure is that known as metonymy, in which a thing is described indirectly, by some name which is invariably associated with it, or by some part of itself ; e.g. The *House* rose ; he was fond of *Virgil ;* a dozen *head* of cattle ; a piece of *china ;* etc.

Effective use is often made of hyperbole or exaggerated statement ; and of its opposite, litotes, an intentional understatement, as in " His work was not bad." Akin to this is the euphemism, in which a harsh and objectionable expression is softened down by words which do not convey the idea so bluntly ; e.g.—

(vii) His veracity is open to question. (= He is a liar.)

Parable and Fable

A prolonged metaphor, accompanied often by personification, yields us the allegory, which is really a tale in which a prolonged comparison is made and sustained throughout, as in Bunyan's " Pilgrim's Progress." A parable is a short allegory, in which a story is told for the sake of the moral truth embodied in it. When similar truths are conveyed through stories of animals, we obtain a fable ; and any little story told for the sake of an ulterior application is often called an apologue.

Other figures of speech are found in poetry ; but as they would in general be out of place in prose we do not refer to them here.

A writer will often say the exact opposite of what he means us to understand, but nevertheless conveys his meaning by the tone of his sentences. This is called irony.

A mildly ironical statement, in which something is hinted at rather than directly expressed, is called an innuendo.

The use of these flowers of speech is appropriate in all compositions in which the imagination or fancy enters ; but they are out of place when lucidity and precision are the chief aim. They are at home in Lamb or Carlyle ; they would, most of them, be out of place in a scientific treatise. In any case they must not be overdone. E. W. E.

From the painting by Daniel Maclise, R.A., in the National Gallery of Ireland.

THE MARRIAGE OF STRONGBOW AND EVA,

the beautiful daughter of Dermot MacMorrogh, King of Leinster. Richard Strongbow, Earl of Pembroke, claimed this girl as the price of his interference in Irish affairs, and he married her in 1170, immediately after his entry into Waterford, while his hands were still dripping with the blood of the luckless citizens whom he had ruthlessly put to the sword.

SPECIAL SUBJECTS

No. 3.—THE IRISH QUESTION: AN HISTORICAL SURVEY

IRELAND in early days stood foremost among Christian nations, and her missionaries did valuable work in the conversion of Britain, Germany, and Gaul. The fierce attacks of the Norsemen, however, did terrible harm, but though they settled at Dublin, Waterford, Cork, and Limerick, they never really amalgamated with the Irish, who kept up their primitive and patriarchal society in the kingdoms of Ulster, Leinster, Meath, Munster, and Connaught under the nominal rule of the "Ard-Righ" or chief king.

William I. had intended to extend his conquest to Ireland, but it was not until the reign of Henry II. that anything in that direction was attempted. By the Synod of Kells (1152) the Irish Church had acknowledged the supremacy of the Pope, and Adrian IV., the only English pontiff, had made the King of England a grant of the island; but it was not until Becket's murder in 1170 that Henry crossed over to reap the results of the invasion of Richard Strongbow, Earl of Pembroke, and his fellow-adventurers of the Welsh Marches.

Edward I.'s Irish Parliament

After receiving the submission of the Irish and their Norman conquerors the king returned in 1172, and though in 1185 he sent his youngest son John to be lord of Ireland, that prince's folly ruined his father's plan, and for centuries English kings did little for Ireland, and the Norman invaders became as unruly and rebellious as the natives themselves.

Under Edward I. an Irish parliament was created, and in 1366 Edward III. caused it to pass the Statute of Kilkenny, a vain attempt to prevent the intermingling of the Anglo-Norman settlers with the natives. Richard II.'s visit in 1394 reduced to momentary obedience the lords of the Pale—the district round Dublin, which was the most thoroughly Anglicised—but during the fifteenth century the English government troubled little about Ireland, though the conciliatory deputyship of Richard of York made the Irish enthusiastic supporters of the White Rose.

With the advent of the Tudors came the turn of the tide. Henry VII. recognised that Ireland required thorough systematic conquest, but, never secure enough on his throne, he was forced to adopt the easier and cheaper method of ruling through the most powerful Anglo-Norman lord, the Earl of Kildare, head of the Fitzgeralds or Geraldines, who fought for his own profit rather than for the king's advantage. Hence for a moment in 1494 Henry tried a stronger policy and appointed an Englishman, Sir Edward Poynings, deputy, who passed his famous statute (1495) making the Irish parliament directly dependent upon the crown.

Poynings' Statute

For nearly three centuries the constitutional relations between England and Ireland were regulated by this statute. Henry VIII., after first tolerating and then being forced to crush the supremacy of the Northern Geraldines (1537), by the advice of Thomas Cromwell adopted a more vigorous policy, and abandoned his father's plan of ruling through the most powerful of the Anglo-Norman families. Henceforth the lord-deputy was an Englishman.

Lord Leonard Grey vindicated the power of the crown over the whole country, but a fresh source of disturbance was now introduced by the Reformation. Nowhere was reform more needed, but the English government missed its opportunity and merely established the royal supremacy, annulled the Pope's jurisdiction, and confiscated Church lands. In 1541 Henry raised Ireland to the dignity of a kingdom, and a prudent deputy, Sir Anthony St. Leger, set to work to convert the Irish chiefs into English nobles and agents of the new policy, and so conciliatory was he that the reforming zeal of the governments of Edward VI. affected Ireland but little.

If the religious question naturally slumbered under Mary, it is to her reign that

the beginning of the land question may be traced in the introduction of the policy of colonisation. Confiscated lands—in the first case those of the O'Connors and O'Mores in Leinster—were sold or granted by the Crown to English planters or settlers, who were to bring colonists over with them and thus to oust the native population. Unfortunately, this method disregarded the rights of the clansmen by looking upon the land as the chief's absolute property, so every plantation meant long and fierce guerilla warfare between intruding English settlers and dispossessed Irish clansmen.

Queen Elizabeth's Policy

With the accession of Elizabeth, Ireland became a burning problem for English statesmen. There were three great rebellions, each really due to causes which Elizabeth had inherited; thus Shane O'Neill's rebellion (1559–69) arose out of her father's attempt to substitute the feudal laws of inheritance for the law of tanistry, which allowed the sept or clan a limited power to elect its chief, while Edward VI.'s religious policy and Mary's scheme of colonisation were unfortunately copied by their sister.

Elizabeth's economy made matters worse, for she starved her deputies and their soldiers, and made enforcement of law and order impossible; while the Irish were kept restless and uneasy by constant colonising schemes. In 1573 the Earl of Essex failed in an Ulster plantation, but in 1570 a serious attempt to colonise Munster resulted in the great rebellion of the Geraldines under the Earl of Desmond. The English government was gradually growing to associate Popery with rebellion, and this tendency was seized on by Desmond's brother Fitzmaurice (1579), who sought to connect Protestantism with the policy of confiscation. Nationalism and Catholicism became identified, and henceforth every rebellion was to be both religious and agrarian.

It was, indeed, the Pope rather than Philip II. of Spain who took up the Irish cause, and in 1580 Gregory XIII. sent 800 Italian and Spanish adventurers, who were captured and massacred at Smerwick by the deputy, Lord Grey de Wilton. By 1583 the rebellion was stamped out so effectually that no Irish chieftain rose to aid the Armada.

Later, the plantation policy of the Irish Privy Council and the papal and Spanish intrigues created a constant unrest in Ulster, of which the ambitious Hugh O'Neill, Earl of Tyrone, availed himself to head a revolt (1595–1603), which proved the most serious of Elizabeth's reign. Obtaining help from Spain, he annihilated Bagnal's forces at Yellow Ford (1598), blarneyed the royal favourite Essex to his ruin, and, when Mountjoy proved too successful in cutting off Spanish reinforcements in Kinsale and in gradually wearing down Irish resistance, submitted and was pardoned in 1603.

The Stuart period opens with the plantation of Ulster. When Sir Arthur Chichester, a wise and moderate deputy, tried to solve the agrarian difficulty by abolishing the common rights of the tribe and making the natives free tenants, his moderation was not approved by his greedy council at Dublin, who procured his removal and the colonisation of Ulster by English and Scottish settlers (1613).

In 1633 Wentworth—soon after created Earl of Strafford—was appointed deputy, and for seven years Ireland was successfully ruled by a strong man, whose actions were dictated by a desire to give material prosperity to the island. He reformed the Church, centralised the royal power, and made the government efficient and self-supporting. By 1640 he had a small active standing army, he had developed the linen trade, he had put down piracy, and had opened up trade with England; but by his carelessness of the means he employed he had not only alarmed the native landowners, but had incurred the hostility of the ruling class.

Under the Stuarts

The execution of Strafford (May, 1641), which was partly secured by the misrepresentations of the Irish Council, encouraged the formidable rebellion which lasted during the period of the Civil War. This rebellion materially contributed to the fall of Charles I., who gave sufficient colour to the belief that he was in league with the Pope to ruin the Protestant cause by the "Glamorgan plot," by which he intrigued, behind his lieutenant Ormonde's back, with the papal nuncio and the rebels for Irish aid against the Parliamentarian forces in England.

Cromwell, who went over in August, 1649, by his pitiless massacre of the royalist garrisons at Drogheda and Wexford, crushed the attempt of the Irish Romanists at separation by May, 1650.

The Restoration brought peace until James II. began his attack on Protestantism in 1687, and his landing at Kinsale (March, 1689) for the recovery of his crown, resulted in a sweeping attack by a Jacobite parliament on Protestantism and English interests.

Then followed the 105 days' siege of Londonderry and its relief by Kirke (July 28th, 1689), the defeat of Berwick at Newtown Butler by the Enniskillen volunteers, William III.'s victory at the Boyne (July 1st, 1690), and finally the ruin of the Stuart cause, a year later, by Ginkel's victory over the Irish and French at Aughrim (July 12th, 1691), and the surrender of Limerick, October 3rd, 1691.

The restoration of the Protestant interest meant retaliation for the savage acts of the Papist parliament of 1689, and the Irish parliament of 1697 unscrupulously agreed to disregard the "articles of Limerick," which had promised "the Roman Catholics of Ireland such privileges as were enjoyed under Charles II."

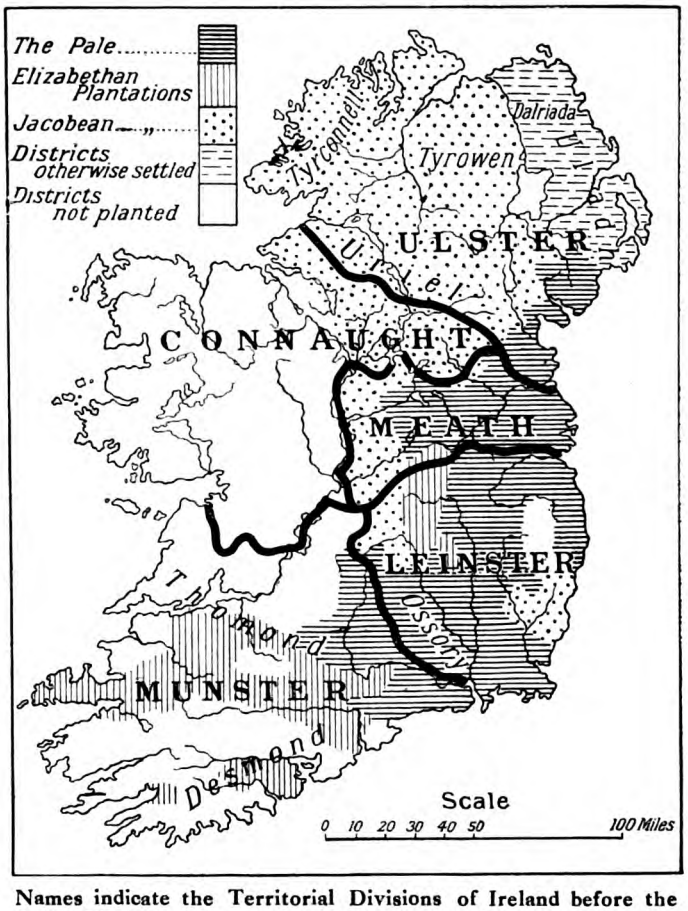
The Broken Treaty

This "Broken Treaty" was also ignored by the parliament of England, which proceeded to legislate for Ireland with the greatest freedom; but the "bloody acts" of William and Anne were undoubtedly inspired by the government at Dublin—the "Castle"—to secure the Protestant supremacy, and to exclude the Romanists from economic and social consideration as well as from political power.

The political history of Ireland during the eighteenth century has been called "the history of the Protestant colony," for the Irish nation lay in a stupor so profound that it did nothing to aid the attempts of 1715 and 1745 against the Hanoverian dynasty.

The English parliament, however, did not allow even the Protestant interest its own way, for in 1719 it passed the famous "Act (6 Geo. I.) for the better securing the dependency of the kingdom of Ireland upon the crown of Great Britain," which declared that "the English parliament hath of right full power to make laws to bind the people and kingdom of Ireland," and deprived the Irish House of Lords of any appellate jurisdiction whatsoever. English jealousy of Irish prosperity dictated too a series of laws which treated the island as a foreign country in the matter of the navigation laws (1696), ruined the woollen and checked the linen trade, and created a feeling of antagonism and suspicion such as enabled Swift to inflame the extraordinary agitation over Wood's Halfpence in 1722.

With the accession of George III. began the constitutional struggle which was to result ultimately in the union with England.



Names indicate the Territorial Divisions of Ireland before the Anglo-Norman invasion, boundaries of provinces being shown by heavy black lines. The shading indicates the Tudor and Stuart Plantations and the extent of the Pale in those times.

The first question was that of parliamentary reform, with a demand for a Septennial Act and for the right to initiate money bills.

It was the American question which really woke up Anglo-Irish politicians, as they conceived that if the English parliament could tax America it would soon tax Ireland too. The war caused great distress in Ireland both by preventing emigration and checking the smuggling trade with France.

Now began two movements for free trade and an independent parliament. In 1778 appeared the Irish Volunteers, a movement

of the Protestant gentry to repel a French invasion which rapidly became political in support of the demand for free trade and a free parliament. The scenes at the famous Dublin volunteer review on College Green in 1779, and Lord North's hasty trade concessions, resulted, on that minister's fall in 1782, in the immediate grant of Home Rule by the new premier Rockingham. The English Act, 6 Geo. I., was repealed, and this was followed by such measures in the newly emancipated Irish parliament as a Habeas Corpus Act, a Mutiny Act, and the establishment of a national bank.

Pitt, who became premier in 1783, agreed with Grattan's efforts for Reform and Emancipation, but in spite of Burke's support he found commercial jealousy and the strength of vested interests in both England and Ireland too much for him. The French Revolution brought matters to a head.

The Act of Union

A Catholic Relief Act, 1793, was followed by the recall in 1795 of the moderate viceroy, Fitzwilliam, a fatal mistake, as it encouraged Wolf Tone, the founder of the Society of United Irishmen, and Lord Edward Fitzgerald, to intrigue with the French with the frank object of separation. The failure of Hoche's invasion and the capture of the Irish leaders caused the rebellion of 1798, which was suppressed by General Lake at Vinegar Hill, in Wexford (June 21st), while another French expedition under Humbert was forced, after a success at Castlebar, to surrender to the new viceroy Cornwallis.

These events drove Pitt and all who feared France to admit the necessity of a union of Great Britain and Ireland.

At last (August 1st, 1800) the Act of Union received the Royal assent. Henceforth Ireland was to be represented in the Imperial Parliament by twenty-eight temporal peers, to be elected for life by the peers of Ireland, four spiritual peers, to be taken in rotation, and one hundred commoners; all members of the united parliament were to take oaths, which excluded Roman Catholics; trade was to be free; the national debts were to be separate, and Ireland was to contribute two-fifths to the Imperial exchequer; the courts of justice were to be untouched; and the continuance of the Protestant Irish Church establishment was to be a fundamental article of the union.

George III.'s obstinate opposition to the political emancipation of the Irish Roman Catholics caused Pitt's resignation in 1801, and his successor Addington had to deal with Emmett's rebellion, which aimed at separation under French protection, but failed (1803), as most Catholics distrusted Napoleon and hated French Revolutionary doctrines. At last, in 1829, the Catholic Relief Act was passed, extorted from the Tories under Wellington and Peel by the agitation caused by Daniel O'Connell, through the Catholic Association (1823) and the Clare election (1828).

This Act enabled Roman Catholics to sit in parliament and to hold all offices save those of Lord Lieutenant and Lord Chancellor. For this concession Ireland felt no gratitude; indeed, the long delay in granting it had stirred up bitter feeling, which O'Connell made use of to start a movement for the repeal of the union. It proved a failure, but his peaceful methods were abandoned by the "Young Ireland" Society, which attempted a rising in the year of revolutions, 1848. The rising, which was easily suppressed, was partly due to the appalling misery of the potato famine (1845–7).

Starvation, disease, and emigration reduced the population of the unfortunate country in six years by 1,700,000. The constant emigration of dissatisfied and revengeful Irish to America resulted in Fenianism, a separatist and revolutionary movement, which revealed Ireland's deep-seated discontent. When Gladstone became premier in 1868 he tried to remove "three branches of the Irish Upas tree—the Church, the land laws, and education." In 1869 the Irish Church was disestablished, and its bishops lost their seats in the House of Lords; but the Land Act of 1870, which for the first time tried to protect the tenant's interests, failed to bring peace to the distressful island, while the Irish University Bill satisfied no one and was thrown out.

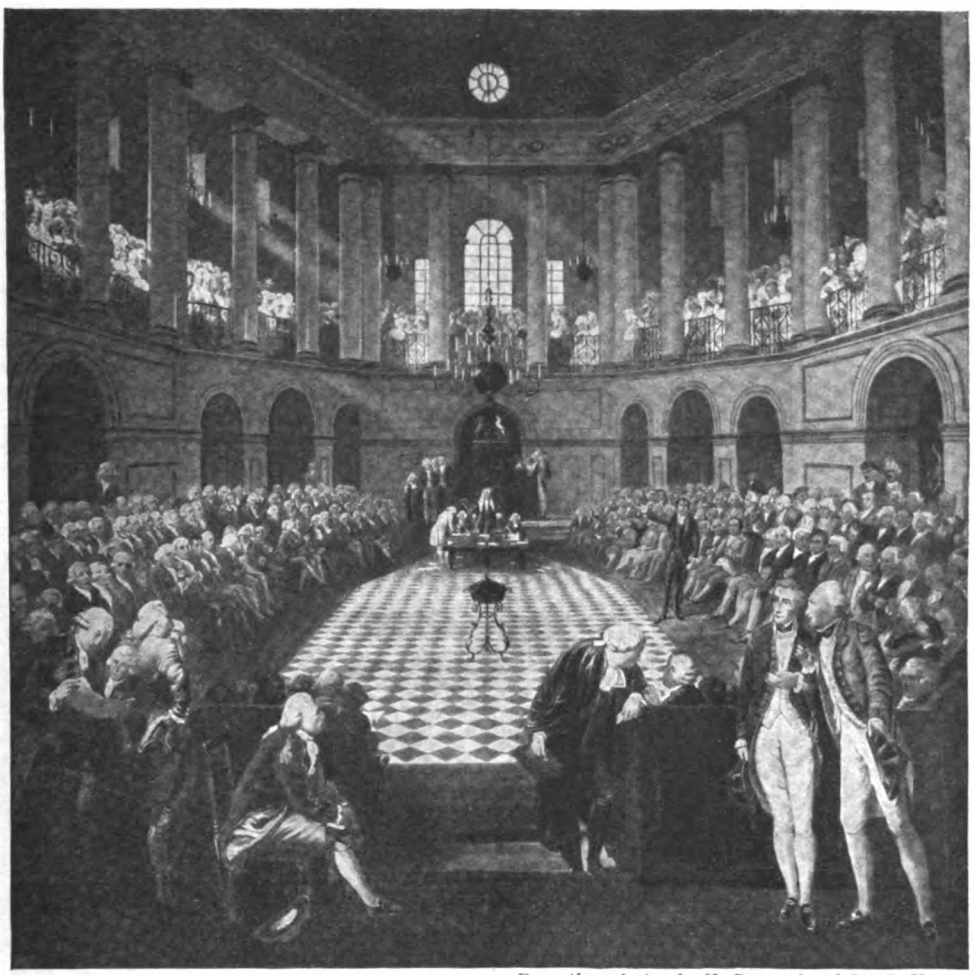
Home Rule Movement

In May, 1870, the Home Rule movement was inaugurated by Isaac Butt. In its inception largely Protestant, it soon became Catholic and Nationalist, and for many years competed with Fenianism for the support of the Irish people, the former movement being parliamentary and constitutional, while the latter, like the recent Sinn Fein movement, was separatist and revolutionary.

Under Charles Stewart Parnell, who succeeded Butt as leader, the Home Rule party was "Americanised in discipline and methods of action, and the League became a 'machine' under the chieftain's control."

His strength was that "he reconciled the Nationalists with the Fenians, and brought both in contact with the economic needs and desires of the peasantry." Irish obstruction in parliament and Michael Davitt's "Land League," with its weapon of boycott, forced Gladstone (1880–5). to try a Gladstone entered upon his third ministry in 1886 to find that the Home Rulers held the balance of power in the House of Commons, he promised Home Rule, as the only alternative to coercion, and a general system of land purchase.

Mr. Gladstone's failure to carry a Home



From the painting by H. Barraud and Sir G. Hayter.

GRATTAN'S PARLIAMENT.

The "Home Rule" Act of 1782 completely separated the English and Irish Parliaments, save in that they had the same sovereign for head. Above is depicted one of the last meetings (in 1790) of this short-lived Irish Parliament. In the foreground, on the right, can be seen Flood and Grattan, in Volunteer uniform.

policy both of coercion, by the Coercion Act (March, 1881) to stop agrarian crime, and conciliation, by the Land Act (August, 1881), which introduced "the three F's"—fair rents, judicially fixed, fixity of tenure and free sale by the tenant of his interests and improvements. Coercion and conciliation, however, alike failed, partly owing to the Phœnix Park murders (1882); but when Rule Bill brought about a big split in the Liberal party, and the general election of 1886 meant for the next twenty years—with a brief interruption (1892–5), when he again failed to carry Home Rule in 1893—a Unionist government of Ireland. From 1886 to 1890 a policy of coercion was followed by "the encouragement of land purchase and the institution of a regime of peasant

proprietors," resulting in the three Land Purchase Acts of 1891, 1896, and 1903, which on the whole were successful in solving the agrarian problem. In 1898 the Local Government Act "substituted the Irish peasant for the squirearchy," and established local self-government through elective councils. Meanwhile, the Home Rule party had suffered a grievous blow in 1890, when Parnell was proved guilty of adultery, and the Irish parliamentary party collapsed into a state of utter "chaos and conflict."

Agricultural Organisation

"Independent voluntary effort, within the domain of economic and social action, has tended to become the watchword of the hour in Ireland," and has resulted in the three new movements of Sir Horace Plunkett's Irish Agricultural Organisation Society, which aimed at co-operation and resulted in 1899 in the institution of the Department of Agricultural and Technical Instruction, of the Gaelic League (1893), which attempts the intellectual "rehabilitation of Ireland," and of the Sinn Fein Society, which opposed the revived Irish parliamentary party under John Redmond, and aims at direct action and separation by "building up a native Irish state side by side with, and ultimately superseding, the alien English State which at present dominates Ireland."

Home Rule Act, 1914

Joining hands with the extreme section of the Labour party, and taking every advantage of the English government's occupation with the Great War, Sinn Fein made an abortive rising in May, 1916. Hostilities opened in Dublin itself; the rebel army having first seized the Post Office, and stationed itself in St. Stephen's Green. Resolute action was taken and the rebellion crushed with but little difficulty.

The return of the Liberals to power in 1906 resulted in a policy of conciliation which produced such measures as the Irish Universities Act, 1908, another Land Act, 1907, and old-age pensions, 1908. Finally, in 1914, Home Rule at last became law under the operation of the Parliament Act of 1910. The Great War, however, postponed its fulfilment, and when, in 1919, Germany affixed her signature to the Peace dictated by the Allied Powers, the Irish Question was still awaiting solution. L. S.

From the picture by Benjamin West in the possession of the Duke of Westminster.

THE BATTLE OF THE BOYNE, 1690,

which resulted in a complete victory for William III. over his father-in-law, James II., ended the Irish hopes of the dethroned Stuart monarch, who, after tarrying a few days in Dublin, fled to France, where he sought the protection of the French King.

Continued from page 408.

SCIENCES:

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CHEMISTRY.—XVI

Symbols, Formulæ, Equations. — The determination of the atomic weight of an element is a task of very great difficulty, far beyond the capacity of the average student, requiring manipulative skill of a high order and often involving the use of elaborate and expensive apparatus. The methods of determination are also constantly being changed with a view to increased accuracy, and hence the atomic weights themselves are altered from time to time.

The following table contains a list of twenty elements with their atomic weights. It will be remarked that the number of decimal places given varies in different cases. This is not arbitrary.

The penultimate place is to be regarded as correct, the figure in the last decimal place given is of doubtful accuracy. The rounded-off values are intended for the use of beginners, and for the arithmetical exercises in this course.

Name.	*Symbol.*	*Atomic Weight.*	
Silver	Ag	107·02	107
Aluminium	Al	26·9	27
Barium	Ba	136·28	136·3
Carbon	C	11·90	12
Calcium	Ca	39·75	40
Chlorine	Cl	35·19	35·2
Copper	Cu	63·07	63
Iron	Fe	55·40	55·5
Hydrogen	H	1	1
Mercury	Hg	199·1	199
Potassium	K	38·79	39
Magnesium	Mg	24·12	24
Nitrogen	N	13·90	14
Sodium	Na	22·82	23
Oxygen	O	15·87	16
Phosphorus	P	30·79	31
Lead	Pb	205·46	205·5
Sulphur	S	31·82	32
Tin	Sn	118·1	118
Zinc	Zn	64·85	65

The second column contains the symbols of the elements. A symbol of an element is composed of the first letter of its English or foreign name, to which in some cases is added a second letter taken from some distinctive part of the word. The symbol is not only an abbreviated form of the full word, but it stands for a definite weight of the element, and, if the Atomic Theory be accepted, the atomic weight. Thus, Fe (from the Latin *ferrum*) represents 55·84 parts by weight of iron, and, also, one atom of iron weighing 55·84 times as much as the hydrogen atom. The student is cautioned against the attempt to learn the list off by heart: he will gradually learn and remember them by frequent use and reference to the table.

The conventional manner of representing the molecule of an element is to place the figure which denotes the atomicity of the element immediately below the right-hand side of the symbol. Thus, H_2 and O_2 represent molecules of hydrogen and oxygen respectively. The atomicity is generally found by dividing the molecular weight by the atomic weight. Thus the molecular weight of sulphur vapour at 500° C. is 186 (twice the density 93), and the atomic weight is 32: hence the atomicity is $186 \div 32 = 6$, and the molecular symbol is S_6. If the atomicity is unknown, the plain symbol of the element is always used.

It is believed that some elements, under certain conditions, do consist of single free atoms, and in such cases the number of atoms concerned in the reaction is given by placing the figure in front of the symbol: thus, 2 H stands for two separate atoms of hydrogen. Further, it may happen that an element exists in two or more different forms (the phenomenon of *allotropy*), and in some cases it is believed that each form contains a different number of atoms in the molecule; in such cases each form receives a different representation; thus O_2 represents a molecule of oxygen, and O_3 a molecule of ozone.

Compounds are represented by formulæ which are made by placing the symbols of the elements contained in it side by side in the correct proportions. Thus, hydrogen chloride is HCl, i.e. it is composed of hydrogen and chlorine in the propor-

tion of 1 of hydrogen to 35·2 of chlorine by weight, and the formula also signifies 36·2 parts by weight of the compound. If the molecular weight of the compound be known, the formula is also made to represent a molecule of it. The molecular weight of hydrogen chloride is 36·2, and therefore the formula HCl stands for one molecule weighing 36·2 times as much as the hydrogen atom. Similarly, H_2O represents a molecule of hydrogen oxide, consisting of two atoms of hydrogen, each weighing 1, and one atom of oxygen weighing 15·87.

In many cases, however, the molecular weight is unknown, and then the formula merely shows the ratio of the number of atoms of each element present; it is called an *empirical* formula. Thus, silica, or oxide of silicon, is depicted as SiO_2, i.e. for every atom of silicon there are two atoms of oxygen; its molecular weight being undetermined, the molecular formula might be SiO_2 or any multiple of it, n (SiO_2), where n is a whole number. If the compound be a gas, its molecular formula will also stand for a definite volume of it; and if the molecular weight be expressed in grams, the volume 22·25 litres at N.T.P. will be implied. Thus, HCl represents 36·2 grams of hydrogen chloride occupying 22·25 litres at N.T.P.

To sum up, the formula of a compound gives (*a*) the elements contained in it, (*b*) the proportions by weight in which those elements are combined, (*c*) a definite weight of it, and if the molecular weight be known, (*d*) it represents a molecule, and gives the molecular weight; and if the compound be gaseous it gives (*e*) the volume of the gram-molecule at N.T.P. Thus we see that a formula imparts a great deal of information in a very concise form; like a symbol, it does not tell us anything new, it merely summarises knowledge already acquired. The following examples will illustrate how a formula is deduced from the results of a chemical analysis:—

(i) A certain mineral was found to contain 46·55 per cent. of iron and 53·45 per cent. of sulphur; it is required to deduce its empirical formula.

The atomic weight of iron is 55·5, and that of sulphur 32. We have learnt that elements combine in the ratio of their equivalents, and that their atomic weights are either equal to, or simple multiples of, the equivalents. Therefore the elements unite in the ratio of their atomic weights, or in some simple multiple of that ratio. The ratio of the number of atoms of iron to the number of atoms of sulphur in the mineral will accordingly be:

$$\frac{46{\cdot}55}{55{\cdot}5} : \frac{53{\cdot}45}{32} \text{ or } \frac{46{\cdot}55}{55{\cdot}5} : \frac{53{\cdot}45}{32} = 0{\cdot}84 : 1{\cdot}68$$

i.e. for every 0·84 of an atom of iron, there are present 1·68 atoms of sulphur. But atoms are indivisible, therefore we must bring these figures to whole numbers (in this case) by dividing the higher figure by the lower. We thus obtain the ratio 1 : 2, and the empirical formula of the mineral is FeS_2.

(ii) Acetylene gas contains 92·3 per cent. of carbon and 7·7 per cent. of hydrogen; its density compared with hydrogen is 13, what is its molecular formula?

Dividing the percentages by the atomic weights, we get carbon = 92·3 ÷ 12, hydrogen = 7·7 ÷ 1 = 7·7. Dividing each quotient by 7·7, we obtain 1 : 1 as the ratio of the number of atoms. Therefore the empirical formula is CH. Since the density is 13, the molecular weight = 2 × 13 = 26. The formula CH implies a molecular weight of (12 + 1) = 13, ∴ the doubled formula C_2H_2 agrees both with the analysis and the vapour density determination.

To deduce the percentage composition of a compound from its formula.

Calculate the percentage composition of sodium chloride from its formula NaCl.

The molecular weight = 23 + 35·2 = 58·2.

Since 58·2 parts by weight contain 23 parts of sodium,

∴ 1 part by weight contains $\frac{23}{58{\cdot}2}$ parts of sodium,

∴ 100 parts by weight contain $\frac{100 \times 23}{58{\cdot}2}$ parts of sodium, = 39·52.

Similarly, the percentage of chlorine is $\frac{100 \times 35{\cdot}2}{58{\cdot}2}$ = 60·48, or this figure might be obtained more simply by subtracting 39·52 from 100.

Equations.—In our early lessons we used to express the main facts of a chemical change by writing the names of the materials involved in the form of an equation, in which the sign + on the left hand side of the equation meant "reacts with" or "combines with," and the sign of equality, =, signified "yield" or "yields." This method can now be extended by writing symbols and formulæ instead of names.

The combination of hydrogen and oxygen to form water, ice, or steam was represented by the equation: hydrogen + oxygen = hydrogen oxide. We have since learnt that (*a*) 1 part by weight of hydrogen combines with 8 parts of oxygen to form 9 parts of water, and (*b*) 2 volumes of hydrogen unite with 1 volume of oxygen to form water, or 2 volumes of steam. Owing to the quantitative significance of symbols and formulæ we are enabled to include these facts in the chemical equation. If we write the latter in the form H + O = HO, we contradict the results of experiment, for 1 of hydrogen does not unite with 16 of oxygen; but the equation $H_2 + O = H_2O$ is in complete harmony with those results. There is, however, one objection to it. We believe that hydrogen and oxygen exist only in the form of molecules; therefore, to represent the change as an action between molecules, we must write the equation: $2H_2 + O_2 = 2H_2O$, i.e. 2 molecules of hydrogen combine with one molecule of oxygen to form two molecules of hydrogen oxide. It should be noted that by multiplying all the quantities in the equation by 2, the relative weights of the substances remain unaltered. Further, if we take H_2 to represent a gram-molecule of hydrogen, and O_2, H_2O gram-molecules of oxygen and steam respectively, the equation accurately expresses the volumetric relations of the substances.

$2H_2 + O_2 = 2H_2O$,

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or 2 vols. + 1 vol. = 2 vols.

Wherever it is possible, a chemical equation should be written in the molecular form. Lastly, it will be noticed that the weights of the materials on each side of the equation are exactly equal, that every atom which appears on the left-hand side reappears on the right-hand side; therefore the equation (and every chemical equation) is a direct illustration of the conservation of matter.

We shall now give a few equations which represent changes already studied, reserving the

remainder for the next and subsequent lessons. Equations usually present a great stumbling block to the beginner, and they require much careful study.

The combustion of elements in air or oxygen. (*Lessons III. and V.*)

Magnesium	$2\,Mg + O_2 = 2\,MgO$
Copper	$2\,Cu + O_2 = 2\,CuO$
Phosphorus	$4\,P + 5\,O_2 = 2\,P_2O_5$
Carbon	$C + O_2 = CO_2$
Sulphur	$S + O_2 = SO_2$

The action of heat upon certain oxides, etc. (*IV.*)

Mercuric oxide ..	$2\,HgO = 2\,Hg + O_2$
Red lead	$2\,Pb_3O_4 = 6\,PbO + O_2$
Barium monoxide (in air)	$2\,BaO + O_2 = 2\,BaO_2$
Barium peroxide ..	$2\,BaO_2 = 2\,BaO + O_2$
Potassium chlorate ..	$2\,KClO_3 = 2\,KCl + 3\,O_2$

Reactions between certain oxides and water.

Carbon dioxide ..	$CO_2 + H_2O = H_2CO_3$
Sulphur dioxide ..	$SO_2 + H_2O = H_2SO_3$
Phosphoric oxide ..	$P_2O_5 + H_2O = 2\,HPO_3$
Sodium oxide	$Na_2O + H_2O = 2\,NaOH$

Equations are of great service to the chemist in enabling him to calculate weights of materials and volumes of gases. Two examples are appended.

(i) What weight of magnesium is required to furnish 100 grams of magnesium oxide ?

We start by writing the equation: $2\,Mg + O_2 = 2\,Mg\,O$.

Introducing the weights, we get: $[2 \times 24] + [2 \times 16] = 2\,[24 + 16]$.

Dividing throughout by 2: $-24 + 16 = 40$.

Thus, 40 grms. of oxide are produced from 24 grms. of metal.

∴ 1 grm. of oxide is produced from 24 grms. of metal.

∴ 100 grms. of oxide are produced from $\frac{100 \times 24}{40}$ grms. of metal = 60 grms. of magnesium.

(ii) Calculate the weight and volume (at N.T.P.) of oxygen obtainable from 1 gram of potassium chlorate (Experiment XV*b*).

$2\,KClO_3 = 2\,KCl + 3\,O_2$.

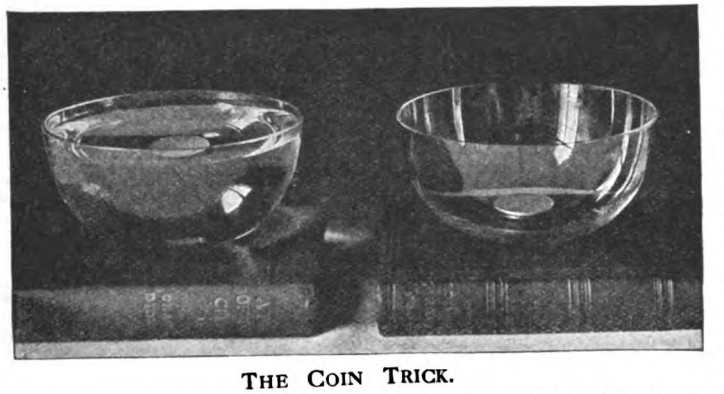
∴ $2\,[39 + 35{\cdot}2 + 48] = 2\,[39 + 35{\cdot}2] + 3\,[2 \times 16]$. Dividing by 2 and adding, 122·2 grms. of chlorate give 48 grms. of oxygen.

∴ 1 grm. of chlorate gives $\frac{48}{122{\cdot}2} = 0{\cdot}39$ grms. of oxygen.

The gram-molecule of oxygen occupies 22·25 litres at N.T.P., i.e., 32 grms. of oxygen occupy 22,250 c.c. at N.T.P.

∴ 0·39 grms. of oxygen occupy $\frac{22{,}250 \times {\cdot}39}{32}$ = 271 c.c.

E. H. T.



THE COIN TRICK.

Take a glass bowl and place a coin in the middle of its base (right); then move the eye so as to make the coin invisible. Now get someone to pour water into the bowl. The coin will immediately come into view.

LIGHT.—IV

12. Refraction.—When light falls on to the surface of a transparent medium, such as water or glass, some of it is reflected according to the law of reflection; but the greater portion passes into and through the medium. Now if we look through a glass window or at any object at the bottom of a bowl of water, we do not notice any apparent change in the object observed; and at first thought

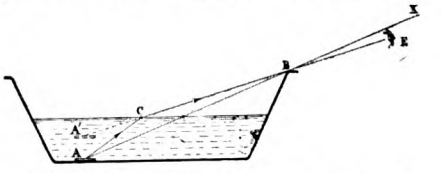


Fig. 30.—Showing how in certain circumstances an object appears to be displaced from its real position.

we should conclude that light passed unchanged from one medium to another. But many simple observations suggest a different view. A stick which is held half in water appears to be bent at the entrance into the water. Objects viewed through a glass lustre, in which the faces of the glass are not parallel, are seen to be displaced from their real position, and to be coloured. These, and many similar phenomena, result from the *refraction*, or bending, of the light as it emerges from one medium into another.

Experiment 1.—Take an ordinary bowl and place a coin in the middle of its base (Fig. 30); then move the eye in such a way that the coin is invisible—i.e. until it is just out of the line of view. Now get someone to pour a little water into the bowl, while you keep the eye in its position. Soon the coin comes clearly into view. Thus the coin and the bottom of the bowl *seem* to be raised by refraction.

Let A, Fig. 30, be the position of the coin, so that the ray A B X, i.e. the ray nearest to the edge of the bowl, just misses the eye E when no water is in the bowl. Draw E B and produce it to meet the surface of the water added at C. Join A C. Then A C B E represents the course of a ray of light by which the point A might be seen. We thus see how the change of direction, or refraction, which occurs at C enables the eye to see A. If there were no refraction, the ray A C would continue in the direction A C and not strike the eye.

And since the course of the ray which enters the eye is C B E, the eye will judge the image of A to be along the line E B produced. Where exactly it will be we can determine by tracing the course of a second ray, as is done in Fig. 31.

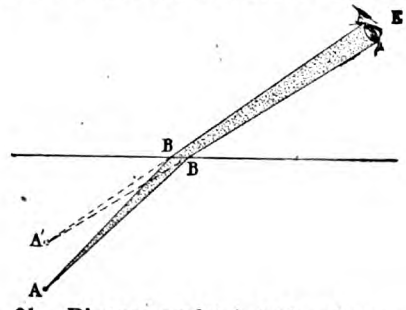


Fig. 31.—Diagram explaining the phenomenon shown in Fig. 30.

Experiment 2.—The same raising of the bottom of a vessel containing water can be shown even more instructively thus: Put a coin at the bottom of a glass gas-jar containing water. Look vertically down into the water, so that the coin is viewed with one eye only, while the other eye is free to observe a coin held in the fingers outside the jar. Adjust the latter coin until it appears to be at the same depth as the one in the jar. This can be done with considerable accuracy if the two eyes are separately focused on the two coins. Measure carefully both the apparent and the real depth of the coin; and repeat the observation for different depths of the water.

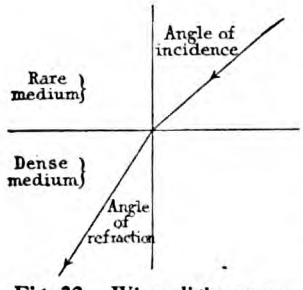


Fig. 32.—When light passes from a rare into a denser medium, the angle of refraction is smaller than the angle of incidence.

If this experiment be done carefully, the interesting result will be obtained that the ratio between the real and the apparent depths is approximately constant, and very nearly equal to $\frac{4}{3}$. This constant we shall presently see is the *refractive index* of water, in reference to air.

When a ray of light passes from air to water, it

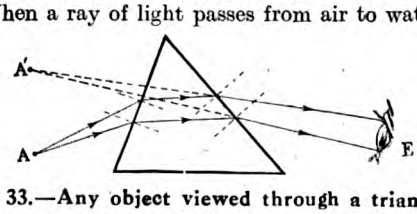


Fig. 33.—Any object viewed through a triangular prism appears to be displaced towards the apex of the prism.

is always refracted towards the normal at the point of incidence: in other words, the angle of refraction is smaller than the angle of incidence (Fig. 32). This is always the case when light passes from a rare medium into a denser one. Optically speaking, glass is denser than water which in its turn is denser than air. With this in mind, we can trace the general course of rays of light from air to glass, or *vice versa*.

Experiment 3.—Take a triangular prism of glass, and look through it at any object in the room. Notice that the object is displaced towards the apex of the prism, and is coloured. The colours we shall deal with later on; at present the student must follow the drawing of Fig. 33, which shows the general reason for the displacement.

Other instances of refraction occur numerously. Sunlight is visible for a long time after the sun has set. Here the refraction occurs at the boundary

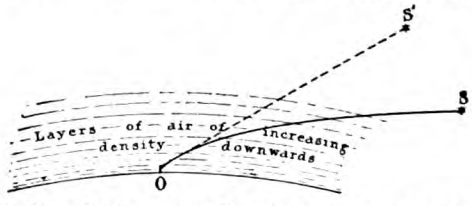


Fig. 34.—Stars—especially those nearest the horizon—are not seen in their exact positions owing to the density of the air through which their light has to pass.

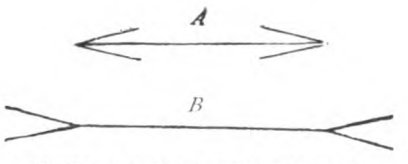
of the air and empty space. But it is also taking place continuously as the light comes through the air, because it is passing from the lighter air high in the atmosphere into the denser air below. The stars too are not seen in their exact positions, especially those which are nearest the horizon, because the light from these has to pass through a greater thickness of air (Fig. 34). The effect of hot air in producing refraction is also shown when objects are viewed through the air above a hot stove. The unsteady flickering is due to the constant movement of the air, and the consequent changes in its refractive power.

One further instance of refraction is the peculiar effect produced by crystals of Iceland Spar. Every incident ray that falls obliquely on these crystals is divided into two rays, which causes all objects seen through them to be double (Fig. 35).

Fig. 35.—Every incident ray that falls obliquely on a crystal of Iceland Spar is divided into two rays.

13. Laws of Refraction.—In order to study in a simple way the principal law of refraction, we take a rectangular block of glass such as an ordinary paper-weight and place it on a sheet of drawing-paper. Fix a pin, P, close to one of the sides of the glass; draw the outline of the block; and with centre, P, describe a circle of such radius as to cut the corners of the block as indicated in Fig. 36. Draw A P A′ at right angles to the edge of the block at P. Replace the glass in position, and fix a pin on the circumference of the circle at A. Then look through the block horizontally, and place the pin A′, so that it appears in the same straight line as P and A. Now place another pin at B, on the circumference of the circle, and find the

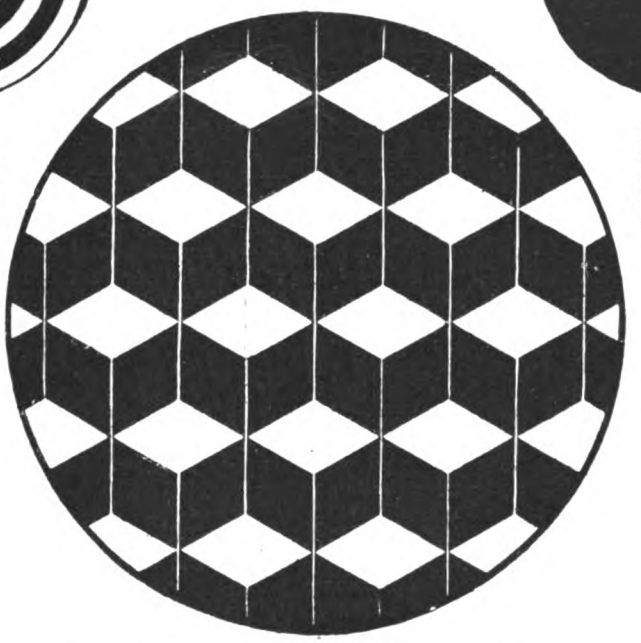
Plateau's disc—i.e. a disc with a spiral band, black and white alternating. If rotated before the eyes, the white band will appear bordered with colours which vary with the rate of rotation.



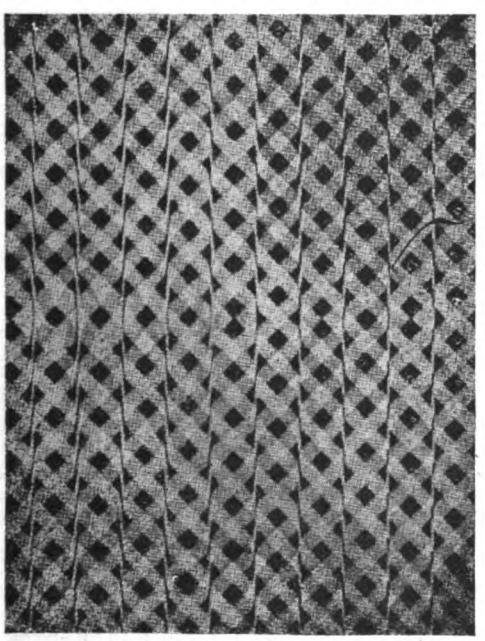
The lines A and B are of the same length.

Benham's Spectrum Top, if rotated, gives concentric chromatic bands of colour which appear in reversed order when the direction of rotation is reversed. Cf. Plateau's disc.

Gaze at this centre figure—



—it will vary in appearance as you gaze.

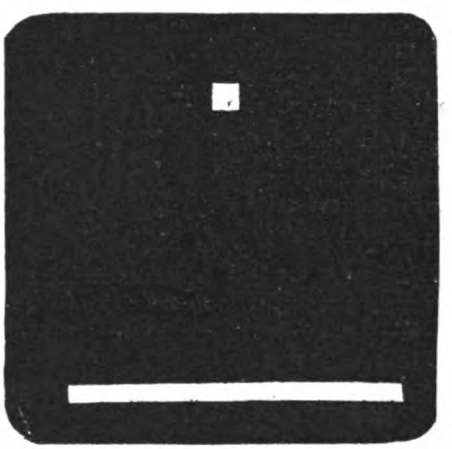


All the lines in the above are parallel!

S S S 8 8 8 *As usually seen.*

S S S 8 8 8 *As seen when inverted.*

S's and 8's are larger below than above. Familiar objects viewed under unfamiliar conditions often reveal similar unsuspected details.



Look steadily at the dot. The line will flicker and disappear, reappearing and disappearing in quick succession. Finally it will vanish.

MORE OPTICAL ILLUSIONS. (*See also page* 395.)

position B′ on the circle as before, so that B P B′ appears to be a straight line. Repeat with other points on the circumference of the circle. We thus have the course of a number of rays of light such as B P, after refraction in the glass as P B′. Remove the glass and draw the lines A P A′, B P B′, etc. You will then notice that in each case the angle of incidence is greater than the angle of refraction, except when it is zero; in that case the course of the ray A P is along the normal and there is no refraction.

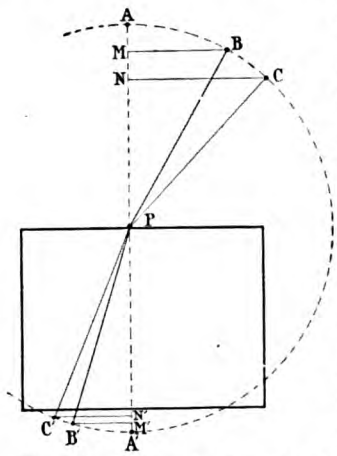


Fig. 36.—Diagram showing a simple way of studying the Law of Refraction.

If you measure carefully what the angles of incidence and refraction are, you will notice that there is no fixed proportion between them. The angle of incidence is not proportional to the angle of refraction: if you double the one you do *not* double the other. The exact connection between the angles can, however, be found by drawing B M, B′ M′, C N, C′ N′, etc., perpendicular to A A′. Measure these lengths for the various rays, and it will be found that the ratio $\frac{B\,M}{B'\,M'} = \frac{C\,N}{C'\,N'}$ = a constant quantity for all the rays.

In order to express the law just suggested in a convenient manner, we need a little trigonometry. In the angle A P B, the ratio $\frac{B\,M}{B\,P}$ is constant, and is called the *sine* of the angle. If we call the angle of incidence i, its sine is represented as sin i and measured by $\frac{B\,M}{B\,P}$. Similarly sin r is the sine of the angle of refraction A′ P B′ and $= \frac{B'\,M'}{B'\,P}$.

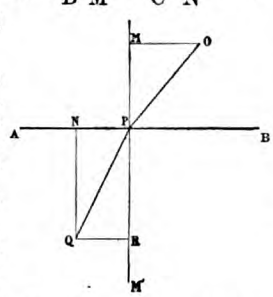


Fig. 37.—The sine of the angle of incidence bears a constant ratio to the sine of the angle of refraction.

Hence $\frac{\sin i}{\sin r} = \frac{\frac{B\,M}{B\,P}}{\frac{B'\,M'}{B'\,P}} = \frac{B\,M}{B'\,M'}$ (because B P = B′ P: which gives the reason for confining B and B′ to the circle).

But $\frac{B\,M}{B'\,M'}$ is, by experiment, constant for all rays.

$\therefore \frac{\sin i}{\sin r}$ is also constant $= \mu$.

This law of refraction is known as *Snell's law of sines*. Expressed in words, it says that *the sine of the angle of incidence bears a constant ratio to the sine of the angle of refraction*. This ratio is expressed by the symbol μ, and is known as the *Refractive Index* of the substance, air being usually taken as the standard.

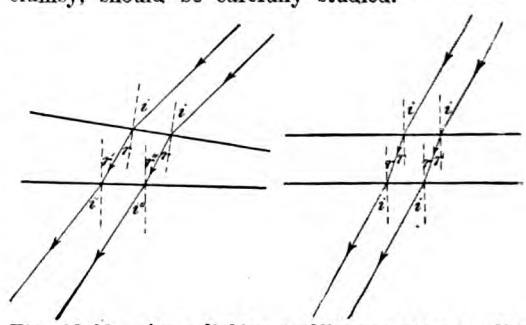
The value of the sines of any angle can be obtained from books of mathematical tables. If, therefore, we know the refractive index of the medium we can trace the course of a ray of light through it. Thus the refractive index of glass is $\frac{3}{2}$: what will be the angle of refraction when a ray of light is incident on it at an angle of 45°?

Here sin i = sin 45° = 0·707.

Hence $\frac{\sin 45°}{\sin r} = \frac{3}{2}$; or 2 sin 45 = 3 sin r; or $\sin r = \frac{2 \times \cdot 707}{3} = \cdot 472\ldots$

From the tables we find that the angle whose sine is 0·472 is 28°.

The course of a refracted ray can be traced, without calling in the aid of trigonometry, by the following construction which, though a little clumsy, should be carefully studied.



Figs. 38, 39.—A parallel beam of light emerges parallel only from a piece of glass whose faces are parallel.

Let A B be the surface of a sheet of water, whose refractive index is $\frac{4}{3}$ (Fig. 37); and let O P be a ray of light incident on the surface at P. Draw M P M′ perpendicular to A B at P. With centre P and a convenient radius P O describe a circle. Draw O M perpendicular to M P. Along P A mark off P N equal in length to $\frac{3}{4}$ O M. Draw N Q perpendicular to A B, to meet the circle at Q. Join P Q, which will give the course of the refracted ray.

For, draw Q R perpendicular to P M′. Then Q R = P N (by geometry) = $\frac{3}{4}$ O M.

Hence $\frac{O\,M}{Q\,R} = \frac{O\,M}{\frac{3}{4}\,O\,M} = \frac{4}{3}$ = refractive index.

So that O P Q is the course of the ray before and after refraction.

When we speak of the refractive index of water as $\frac{4}{3}$, we refer to the passage of light from air to water. But if the course of the light is reversed, the refractive index is inverted also, and becomes $\frac{3}{4}$. Thus if i = the angle of incidence in air, and r the corresponding angle of refraction in water, i would be the angle of refraction in air corresponding to an angle of incidence r in water. To emphasise this point, the student should draw carefully the course of two parallel rays incident obliquely on a parallel plate of glass ($\mu = \frac{3}{2}$). He will thus notice why a parallel beam of light emerges parallel from such a plate, but not from a piece of glass whose faces are not parallel (Cp Fig. 38 with Fig. 39).

E. W. E.

ELECTRICITY AND MAGNETISM.—IV

Terrestrial Magnetism.—The earth itself has magnetic properties. It may contain a mass of magnetic matter or it may derive its magnetism from some other source. At present the origin of terrestrial magnetism is unknown, and until future investigations have thrown more light on the subject we may assume, as a working theory, that the earth contains a huge magnetic mass running through its centre, with the magnetic poles near, but not quite in the same position as the geographical poles. Since any magnet has its own field we should be able to examine experimentally the magnetic field of the earth.

It has been noticed that pieces of iron and steel become magnetised by induction when they are within a magnetic field, and one may reasonably ask why iron pipes and steel machines are not normally in the magnetic condition since they are within the earth's magnetic field. Again, how is it that iron filings on a sheet of paper do not arrange themselves in a definite pattern indicating the direction of lines of force in the earth's field? The answer to these questions is a simple matter. Iron filings have to be magnetised by induction before they will assume a pattern indicating the direction of magnetic force, and the earth's magnetism is too feeble to induce perceptible magnetism in them.

If the magnetic influence of the earth were much stronger than it is, all magnetic bodies whose molecules were capable of remaining undisturbed would be magnets by induction.

The scientific method of thought is not satisfied by mere statements, so that it is necessary for us to show by experiment that the earth really has magnetic properties, and the use of steel magnets, which do not require any induced magnetism, will enable us to do this.

Experiment 13.—*To find the direction of the earth's magnetism in a horizontal plane.*

Place a sheet of white paper about a foot long by eight inches in width on a table. Put the compass on the paper near one of its longer edges and allow the needle to come to rest in the magnetic meridian. Then carefully adjust the paper so that the longer edge (x) is parallel with the axis of the compass needle. The compass will indicate which end of the paper is its southern edge (*y*), and along this mark off several points at intervals of half an inch Number the points 1, 2, 3, and so on. Without moving the paper place the compass just in front of the mark 1 and put a pencil dot on the paper immediately in front of the position of the north pole when it is at rest. Move the compass forward until its south pole is just in front of the pencil dot, and again mark the position of the north pole. Proceed in this way until the further edge of the paper has been reached, then draw a line passing through all the dots. Start again at mark 2, and proceed to plot a line as before. Do the same from marks 3, 4, etc., always finishing one line before commencing the next.

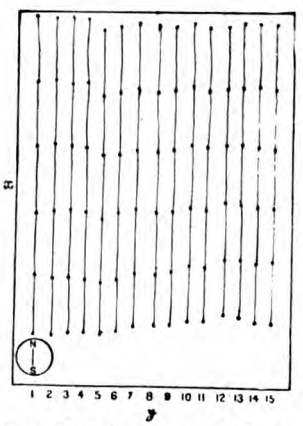


Fig. 14.—To find the direction of the earth's magnetism in a horizontal plane.

The experiment has supplied us with a diagram containing a number of straight lines extending in a direction nearly north and south, and parallel with one another. What do these lines teach us?

Their parallelism shows that the earth's magnetic field is uniform at the place where the experiment is performed. Curved lines indicate a field whose intensity varies at different points. The approximately north and south direction of the lines in our diagram indicates the direction of the earth's magnetic influence over a magnet free to move in a horizontal plane. The question whether the earth's influence over a magnet is a pulling force or merely a directive one now confronts us.

Experiment 14.—*To determine whether the earth's magnetic force is merely directive or not.*

Float a magnetised knitting needle on a piece of wood in a large bowl of water. Place the wood carefully in the middle so that it has no motion towards the edge of the bowl in any direction. The needle floats round until it lies in a roughly north and south direction, but it does not move forward to any part of the bowl's edge.

The earth's influence is evidently directive only. The reason for this is simple. Owing to the relatively enormous size of the earth, its magnetic poles are practically at the same distance from either pole of the needle. The length of the needle is so small in comparison that one pole is as much influenced by the earth as the other.

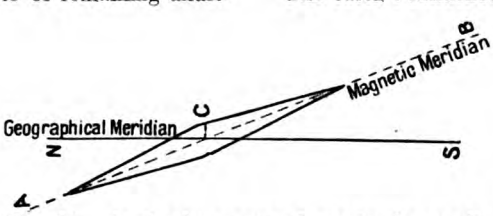


Fig. 15.—A freely mounted magnetic needle always comes to rest in a direction that is not a true geographical north and south line.

Declination.—A freely mounted magnetised needle always comes to rest in a direction that is not a true geographical north and south line.

Our working explanation is that the earth's magnetic poles are not in the same places as the geographical poles, and the geographical meridian or line connecting the geographical poles and passing through the place where we are situated, is not coincident with the magnetic meridian or line joining the magnetic poles of the earth and passing through our place of observation.

It will be noticed that the two kinds of meridians

intersect, forming an angle, the size of which, measured in degrees, is known as the magnetic Declination.

Experiment 15.—*To determine the declination.*

Select a room having a south aspect and place a table near the window. See that the surface of the table is horizontal by testing with a spirit level, or a marble which will move along a hard topped table if the surface is inclined. At 12 o'clock noon, when the sun is directly south, hold a ruler vertically on the table. A home-made plumb line (i.e. a weight on a string) will indicate whether the ruler is vertical or not. When the ruler is exactly vertical its shadow on the table will be in the geographical meridian, and the end of the shadow furthest away from the ruler will indicate the geographical north. Make a chalk line along the shadow on the table and remove the ruler. Place a compass with its north and south *marks* on the chalk line. The needle will not be along the line, but will make an angle with it. This angle, which can be read on the graduated scale of the compass, is the magnetic declination *at the place of observation.*

THE MARINER'S COMPASS
consists of a magnet screened from the influence of surrounding iron and steel, and mounted on gimbals so that it is always horizontal.

We have seen by experiment that at any particular place, which is only a very small portion of the earth's surface, the earth's magnetic field is uniform, but the results of experiments at many places show that the magnetism of the earth *as a whole* is not uniform. The declination is not the same at all parts of the earth's surface. At the present time in the British Isles it is about 15 degrees west. Charts showing the declination at various places have been constructed, since navigators must allow for it in steering, for any particular place.

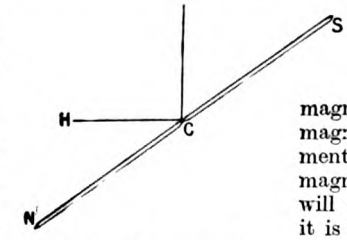


Fig. 16.—A suspended magnetised needle will arrange itself in the path it would follow towards the magnetic north pole.

The Mariner's compass consists of a magnet screened from the influence of surrounding iron or steel objects, and mounted on gimbals in such a way that, however the ship may roll, the compass remains horizontal. Unlike an ordinary compass, the card is mounted rigidly on the magnet and moves with it.

In Experiment 13, when we traced the earth's directive magnetic force, was the compass needle free to move in any direction ? It certainly could not move in an up and down direction, and if we are to trace actual lines of force in the earth's field we must use a magnetised needle that is free to move vertically as well as horizontally.

Experiment 16.—*To trace lines of force in the earth's magnetic field and to determine the dip or inclination.*

Fasten a fibre of unspun silk to the middle of a steel knitting needle, and adjust the connection until the needle hangs horizontally. Note the position of the thread and make a file mark so that on re-attaching the fibre you find that, however the needle may move vertically, it will not slip off. Now magnetise the needle by single touch. It no longer hangs horizontally, but one end dips towards the far distant magnetic north pole of the earth. Also it lies in the magnetic meridian. The needle has arranged itself in the path it would follow towards the magnetic north pole of the earth, hence a straight line passing along the axis of the needle is a line of force in the earth's field. The angle which the inclined needle now makes with the horizontal is called the Magnetic Inclination or Dip.

Both inclination and declination are usually determined by special instruments known as dip needles and declination needles respectively.

Experiments with dip needles have shown that the dip varies considerably at different parts of the earth's surface, though many places may have the same dip. Midway between the terrestrial magnetic poles there is no dip, whereas near the magnetic north and south the inclination is very high.

Since geographical and magnetic poles of the earth do not coincide, the line of no dip (called the Aclinic Line) will not be in the same position as the equator, the line of no Latitude.

It has been shown that the lines of force in the earth's field extend in the direction of the dip needle, and if a bar of steel is so placed that it hangs in the magnetic meridian and dips to the extent of the magnetic inclination at the place of the experiment, the earth's magnetism will induce feeble magnetic properties in the bar. These properties will not make themselves apparent at once, and it is well to tap the bar sometimes in order to assist its molecules to arrange themselves.

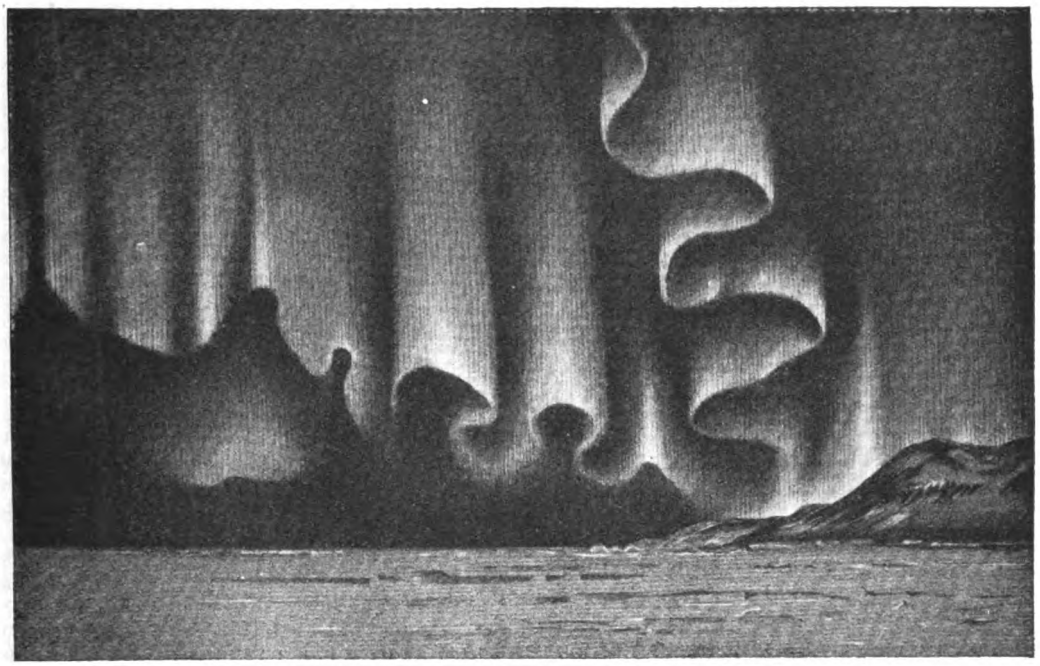
To prove that a dip needle is not influenced by a force of attraction other than that of gravitation, we have only to weigh a needle before and after magnetisation.

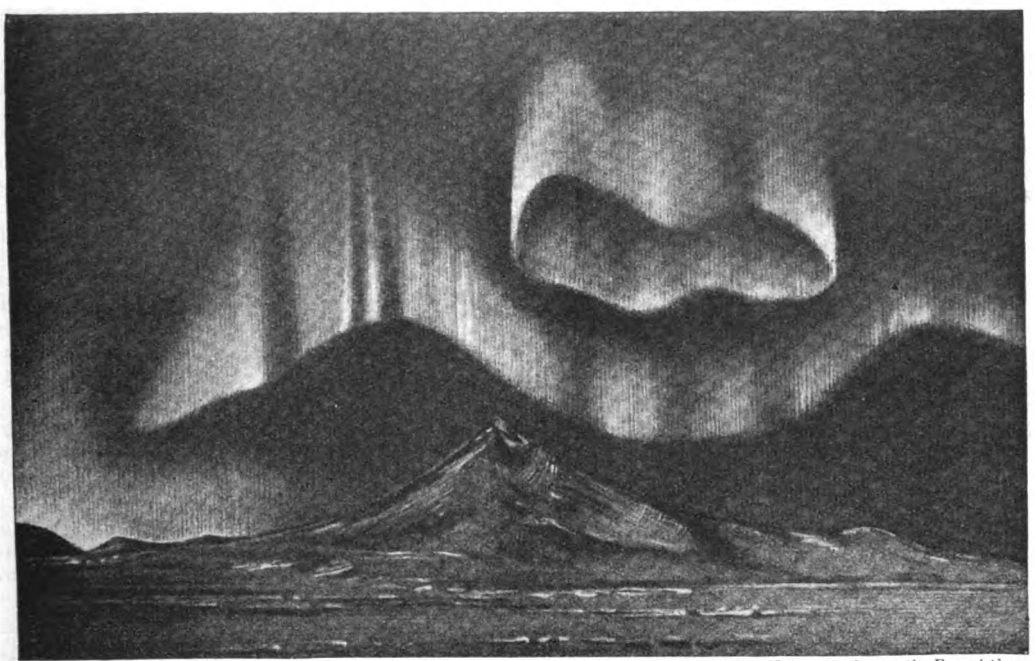
If the earth's magnetism tended to pull a magnet downwards this pulling force would be added to that of gravitation and a needle should weigh more after magnetisation. But such is not the case.

Since the compass is of such immense importance in navigation, land surveying, etc., we must admit that the most valuable feature of the earth's magnetism is its directive force. But the earth's magnetic poles do not remain always in the same positions. Very slowly they move eastwards or westwards, as the case may be, thus rendering necessary the preparation of new charts, etc.

It is, perhaps, more correct to say that the *geographical* poles slowly shift their positions so that the relative positions of the two kinds of poles undergo alteration.

L. M. P.





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THE ANTARCTIC AURORA BOREALIS.

The Aurora Borealis—so called because it was first seen in northern skies—is a feature of the Antarctic region no less than of the Arctic. It is an electrical effect which, according to some evidence, is soundless and, according to other evidence, is accompanied by a dull rushing sound or the noise of rustling silk. Its manifestations vary greatly in brilliancy, shape and colour. Above are shown two examples of the Auroral Curtain in its most remarkable form.

ETHNOLOGY.—III

MAN first conceived the idea of tunnelling in grubbing for roots, in making burrows in which to hide himself from the elements or from his enemies. He dug first with his claws as a baboon does, but soon found this painful and ineffective and applied a sharp-pointed stick to the same purpose, or the prongs of a deer's antlers, the tusk of an elephant or a bull's horn with a club driven into its hollow. In this way arose the pickaxe, in which metal in course of time has supplanted wood, horn, tooth and stone. From such needs also, where hard rock had to be pierced, arose the drill, the drill pointed with precious stones even as early as the Egyptian work of 6,000 or 7,000 years ago.

Desiring to obtain metals when the age of metals began, Man tunnelled more and more adroitly until he is now mining at more than a mile below the earth's surface, until the mere depth of the channels between Britain and Ireland, England and France, and even Algeciras and Tangier, is not the chief difficulty in the way of continuous railway communication between those lands. In the growth of the ship, the vessels of to-day have arisen from the hollowed tree-trunk (poled with long sticks, or paddled with broad ones), or a number of small sticks tied together with lianas and used as a raft. Where sticks were not easily obtained, bundles of papyrus and other reeds were tied together with grass. Structures of this kind were made further watertight by the wrapping round them of skins or of flexible bark; or they were caulked with pitch and clay.

The canoe which grew out of the hollowed tree trunk all in one piece, was probably a blind alley of invention, and it was more likely the constructive idea of the raft that expanded into the coracle, the birch-bark canoe, the early Egyptian vessels, and those of the Mediterranean and the North Sea, which were made of a number of pieces, and not out of a single receptacle. The power of the wind was soon appreciated, and was made use of by sticking some huge, heavily-feathered branch or palm frond into the prow of the vessel. Then, where this was too uncertain, straight branches or tree stems were inserted in more solidly built vessels, and mats were tied against them at right-angles, and later than mats, woven fabrics: in short, the sail.

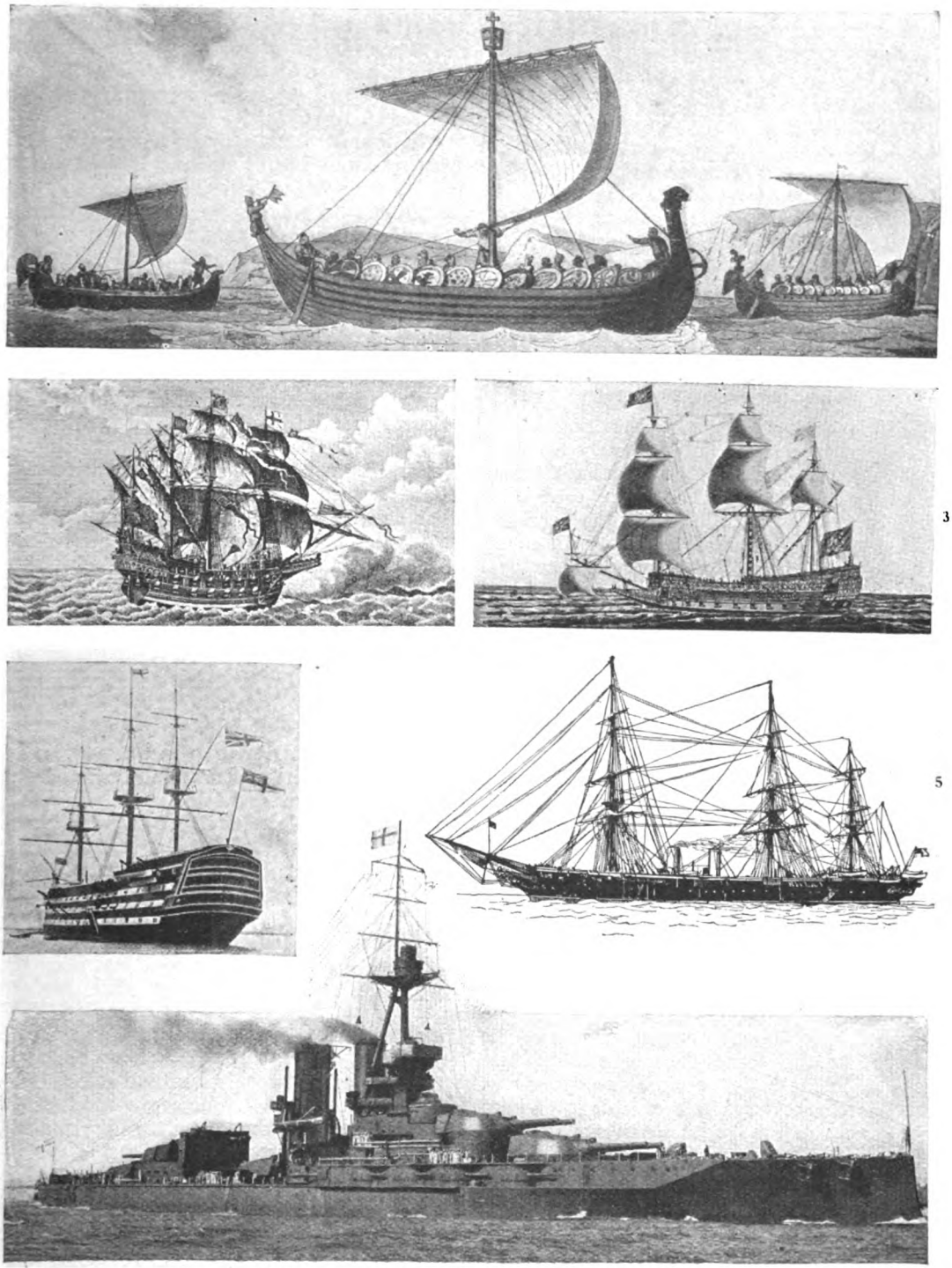
A PRESENT-DAY SEVERN CORACLE.

Seen from above and at side. The canoe, which grew out of the hollowed tree-trunk all in one piece, was a blind alley of invention. The great ships of to-day were evolved from the raft, a constructive design which later developed into the coracle, made out of a number of pieces, not a single receptacle.

The developments of Man's cooking has been interesting to contemplate. Before he was wholly man, but when he was increasingly carnivorous, he appreciated the advantages of tender over tough meat. He found, as do some of the most completely savage people in Africa at the present day, that if he buried or put away dead animals, or even human bodies when he was a cannibal, until they became high, the flesh was much more easily masticated, even if it had an unpleasant taste (over which in those days he was not particular). He also found that roots as well as flesh when soaked in water were easier to masticate.

Ever and anon, fires arose through the action of lightning, and when a great prairie of grass caught fire, in the trail of the flames would remain the charred bodies of many a small beast, bird, and reptile. This naturally cooked food seemed to man delicious. He also profited, no doubt, from the use of the many hot springs distributed about the earth's surface.

Fish caught from the cold rivers close by and dropped into these hot springs were cooked quickly. About the time that he was becoming partial to cooked food, or food that was made more easily digestible by



EVOLUTION OF THE FIGHTING SHIP.

1. Ships of William the Conqueror; 2. The *Great Harry*, built in the reign of Henry VII.; 3. The *Sovereign of the Seas*, built in 1637 (*1, 2, and 3 are reproduced from old prints by kind permission of Messrs. T. H. Parker*); **4. The *Victory*, Nelson's flagship; 5. H.M.S. *Warrior*, built in 1861; 6. H.M.S. *Iron Duke*** (*photo: Stephen Cribb, Southsea*).

artificial means, he had discovered for himself how to create fire, and soon afterwards how to boil water. First of all in this respect he would have used hollow stones, of which there are many by the sides of the rivers; and in the most primitive days of humanity the river-side and the sea-shore were the favourite regions for colonisation.

Food at first was merely cooked by being singed or grilled or roasted in the ashes. Then came the idea of baking it in the earth with the application of hot ashes or boiling it in tough calabashes or hollowed stones. Long afterwards into the growth of the cooking utensil entered the idea of pottery.

Evolution of Pottery

Pottery grew out of basket-making. The already supple fingers of the early humans had taken to plaiting straws and all forms of easily obtained vegetable fibre, especially the bast of palms. From the earliest basket-making arose along another line of development the idea of weaving or the idea of sewing. Holes were made with sharp thorns or splinters of bone, and through these the guts of animals or the twisted fibre or long grass were thrust. Then a hole was made in the needle, and that carried the thread through much more quickly and certainly.

One day it occurred to some woman who had made a closely plaited basket, to smear the outside of it with clay to make it less permeable. The clay dried in the sun and the woman was then able to carry liquids in this receptacle. Then perhaps on another occasion when the clay did not dry quick enough, she dried it by or on the fire. And gradually the idea came about that a basket lined inside and out with clay could be safely put on the fire without being burnt.

Gradually the basket work foundation was dropped, and the clay vessel made straight away. At the same time also Man had become increasingly adroit at scooping and carving the softer kinds of stone. Whilst one tribe would make its cooking vessels out of clay, another would scoop them out of limestone or soapstone, or other carvable material. Thus it became possible to boil food, to make soup, to heat water for medicinal purposes.

The green, sappy twig skewers which had held up pieces of meat to roast expanded into a wooden and then a metal gridiron; the shallow clay vessel with a wooden handle into a frying-pan, the clay oven into a metal oven; and so at the other end of the humble wood fire of the primitive savage, with its cooking-stones and its wooden skewers, we have the vastly complicated kitchen ranges of to-day, heated no longer by wood, scarcely even by coal, as often as not by gas or electricity.

The growth of cooking further inducted man into the use of steam. His primitive kettles were found to boil better or to stew better if a lid was placed over the opening. Directly liquid was confined the power of steam made itself apparent, and from out of the steaming kettle arose the locomotive and the vast changes made in the world during the past hundred years by the application of steam power.

Chemistry and medicine had similar simple origins, connected partly with botanical and mineral research and partly with religious ideas and mysticism.

Man soon became acquainted with the effect of poisons, that is to say, soon realised that certain substances, mineral, vegetable, and animal, were deadly. But sometimes when the dose was slight, instead of killing him they cured him from some malady from which he suffered. There were the hot mineral springs not only pleasant in their temperature, but in some mysterious way curative of bodily troubles inside and out.

Medicine and Alcohol

Early in his career man had a craving for salt and experiments in salt-tasting, and the search for this mineral stimulus led no doubt to many a violent death, but to a great accumulation of knowledge. Perhaps the earliest ideas of medicine were associated with the tree. In fact, amongst many African tribes at the present day, the word for medicine is the same as the word—generally the old word—for tree; because it was from the vegetable world that early Man derived most of his poisons and his remedies. The poisoned arrow was comparatively an early invention, while through a long series of puzzling out between cause and effect early man realised that a stone arrow-head thrust into decaying animal matter or smeared with snake poison or with the sap of certain plants, was far more deadly in its effect than the unpoisoned arrow-head.

The sap of palm-trees or of sugar-canes or the juice of grapes was delicious as a drink, and the prudent amongst the primitive savages wished to store up for after consumption what they could not finish at a single sitting. Then it fermented, and man realised the potency of alcohol, which has since been to him more of a curse than a blessing. Yet distilled alcohol is quite a recent inven-

tion, possibly of the Arab chemists of the Middle Ages, when for two or three centuries Spain, Tunis, Egypt and Syria led the way in scientific research, before Islam was blighted and blasted for ever afterwards by the incoming of the Turk and the Tatar.

Arab chemists realised that the essence, so to speak, of wine or of other liquids might be obtained by boiling the liquid and collecting, distilling, its steam. To such essences they gave the name al-kuh'l, originally applied to powdered antimony, and derived from a root, kahala, meaning "paint," from which the mediæval term alcohol was derived and used by the alchemists, who were the lineal ancestors of our chemists.

Chemistry as a science arose in the minds of the Greeks during the first thousand years before the Christian era; and the root word from which its name is derived through the Arabic is *chymeia*, meaning "an infusion." The Arabs, when they first settled down after raiding and ravaging the Eastern Empire, took over from the Byzantine Greeks much of their science and of the names they applied scientifically. Thus this science of experimenting with liquids and gases and minerals was known in Arabic as "al-kimia," and easily became "alchemy" in the Romance languages of mediæval Europe.

Early chemistry concerned itself almost entirely with palpable and visible substances, solids or liquids; it was only dimly conscious of that much more diffused form of matter which we know as gas. The very term gas was not invented till the seventeenth century.

In that century civilised mankind began to concern itself much more with gases than hitherto. Oxygen and hydrogen were defined as some of the component gases of the atmosphere. The sensitiveness of mercury was understood, and the barometer and thermometer were invented or suggested. By the close of the nineteenth century an advance in such knowledge (almost staggering when one compares the million years of ignorance behind it) was made in regard to our control over gases, light, and electricity, so that we now may be said without exagger-

Photo: Sir H. H. Johnston.

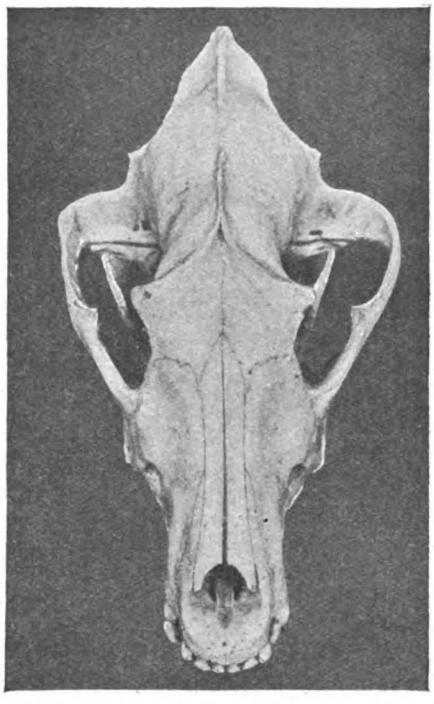
THE SALT PANS ON LAKE EDWARD, UGANDA PROTECTORATE.

Early in his career, man had a craving for salt, and experiments in salt tasting and the search for this mineral stimulus led, no doubt, to many a violent death, but to a great accumulation of knowledge.

ation to wield the powers of a god rather than those of a mere animal.

Another fascinating branch of ethnological study is that of man's increasing influence as a creator, as a ruler over the other forms of life on this planet. Far back in his history when he was scarcely more than a hunting ape, he was accustoming himself to contact with the dog.

There is some curious, natural, and as yet unexplained, sympathy and liking between



SKULL OF AN AMERICAN WOLF.

monkeys, apes, and dogs. I have lost my way in the equatorial forest of West Africa, accompanied only by a little dog, an English terrier; and a huge chimpanzi has dropped from the branches, not necessarily to attack me, but to seize and investigate my dog—with no intention of tearing him limb from limb; on the contrary, with a curious desire to fondle, a desire that the dog does not repudiate by a frightened attack. Introduce a dog to a baboon, a monkey, or an ape, and you will nearly always see that they make friends at once. It is not so with the wolf, I should imagine.

The wolf, though so nearly allied to the domestic dog that it is possibly one of its ancestors, was amongst the most dreaded of Man's early enemies. Nevertheless, variants of the wolf species, types akin to the dingo of Australia, and possibly to the wild ancestors of the Eskimo and the Chow, canine animals that hunted in packs, conceived the idea of associating themselves with the raids of the proto-human.

These wild dogs—then no doubt ranging over much of the northern part of the Old World—began to follow in the wake of the Eolithic and Palaeolithic hunters. Like jackals (to which, perhaps, they were distantly allied) they feasted on the remains which the hunting men could not devour or carry away. Being first-class hunters themselves, they soon took to co-operating with early man. He became used to them as allies, tolerated them, and at last took them to some extent into his keeping. Stray puppies were taken pity on by women and were brought up with the human clan, whose interests, when they grew up, they defended with even greater zeal than they had shown on behalf of the dog-pack from which they were descended.

Sometimes, no doubt, there was little

SKULL OF A RETRIEVER.

discrimination made between the puppies of wolves and the puppies of the wild dog (itself a creature whose face was broader than that of the wolf, and whose tail recurved more naturally and persistently over the back, and whose hind-quarters were higher and less slinking). The early domestic dogs of man had a strong wolf strain ever and

again renewed. Some of the dogs of the west of Ireland at the present day are little else than dwarf wolves; and the same may be said about the dogs of Lapland, Norway, and parts of Central and Eastern Europe. Farther south in the Mediterranean basin the jackal may have interbred with the domesticated breeds of dog.

In Central Asia the big-jawed, big-muzzled mastiff type grew out of Chow ancestors (the Chow of China is very like what the primitive type of domesticated dog must have been, if we could see it). In the desert regions or the upland plains the hunting dogs grew into the greyhound type, with longer limbs and slenderer muzzles. Elsewhere it was the collie, a domesticated wolf or wolf hybrid, which instead of attacking took to defending the tamed mouflon-sheep or goats of its human masters.

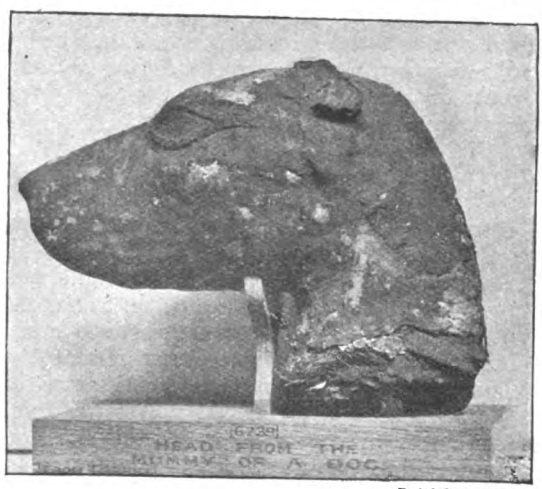
The dog was the earliest of man's domesticated animals, and for a long time—ages, no doubt, after this first step—no other beast was brought within the circle of man's home. But as mankind in Western Asia or

British Museum.

A Græco-Roman group of dogs of greyhound type, found at Monte Cagnolo, near the ancient Lanuvium.

Eastern Europe or the Mediterranean basin became less and less of a nomad, cared more and more for a fixed and settled dwelling, he began, and proceeded with rapid progression, to domesticate other creatures. The kids and lambs of ibex and wild sheep, the fawns of antelopes, the calves of wild cattle, the colts of asses and horses were not killed, but after being caught were perhaps kept to grow larger.

Then the idea occurred of allowing them to breed and to perpetuate themselves within the circle of human control. Man became a pastor, a shepherd, a cowherd. Similarly, he allowed birds to grow tame in his sur-



British Museum.

Mummy head of an Egyptian hound, found at Thebes. It measures nine inches from nose to occiput.

roundings—geese and ducks, rock-pigeons, guinea-fowl, and partridges.

The domestic fowl originated in Southern Asia.

In the jungles of that region, from India to Java and Ceylon, there are various beautiful types of pheasant of the genus *Gallus*, pheasants with broad tails like bent fans, with fleshy adornments on the head and face and abundant neck-feathers (hackles). These for some reason attracted the attention of the Aryan and Aryanised people of India and Malaysia. They were domesticated, like the amazingly beautiful peacock. Their eggs were found to be palatable as well as their flesh.

The crowing powers of the cock and its regular hours of waking and saluting three stages of the coming day, made it a bird of note and usefulness. It was exported to Persia and the Persians passed it on to the Greeks and to the Egyptians. From Egypt it spread all over Negro Africa, except amongst the Hottentots, the Bushmen and the Pygmies, and from Greece it reached parts of Europe; just as from Burma it spread to China and Japan, New Guinea, New Caledonia, and the Polynesian Islands. From Spain, from Portugal, from France and Britain, it was conveyed to America, and in

a very few years had reached many of the tribes of South and North America.

Then as regards cultivated plants. Palaeolithic Man, still a hunter and scarcely more than a hunter, noticed by degrees that when his women collected the wild grain, the wild pumpkins and the edible roots with which they tempered their flesh diet, and when seeds or fragments of these plants fell amongst the kitchen middens, the heaps of refuse and manure, or of soil that had had most of its native vegetation removed, they grew up with unusual luxuriance.

Cultivating Plants

Gradually he conceived the idea, as he entered the Neolithic age of improved stone implements, of weeding, of deliberately planting, of breaking up the ground and preparing it for vegetable growth, as well as of storing the food thus acquired to carry him through times and seasons of scarcity. Thus taking in hand some wild grass of Western Asia he produced wheat, or from another form barley, from others oats and rye, millet, sorghum, and eleusine. In America in the course of centuries, perhaps of thousands of years, he produced by cultivation and artificial selection the most valuable of all grains, maize.

Again, in Western and South-western Asia he developed out of the crab-tree the cultivated apple, out of kindred species the pear and quince. From various forms of wild plum he created the luscious and delicious plums of to-day, the greengage, the apricot, the peach, the nectarine, the almond, and the cherry. Far away in South-eastern Asia, from out of intensely acid aromatic and thickly rinded fruits he shaped the orange, the lemon, the shaddock, the grape-fruit, and all the other glorious and never-sufficiently-to-be-thanked products of the orange family. Early also in his civilised career in such regions he improved the pithy, black-seeded, tubular fruit of the *Musa* genus (a member of the moisture-loving *Musaceæ* order) into the banana and plantain.

Similarly, and by slow degrees, he created the luscious mango out of a nasty thick-rinded, turpentine-tasting, big-stoned fruit. He fostered in northern South America the pineapple, from a thing you would scarcely recognise as being any relation of the cultivated pine—just the thick, flower-studded stem of a long, spiny-leafed *Bromelia*. The wild pumpkins became melons and cucumbers, wild leguminous plants with hard or bitter seeds gave us the delicious peas and beans and lentils of the present day.

Sugar and Potatoes

A wild sea-coast plant with thick fleshy, smelly leaves, became the cabbage, the cauliflower, the broccoli. Other forms of wild cabbage were made to develop their roots into huge tubers, and became turnips, swedes, radishes. The sugar-cane and other allied forms of reed were made to produce greater and greater quantities of sugar, first in Asia and Africa, and long afterwards for export to Europe and for growth in America.

The potato (in western North and South America) was another example of cultivation, for the original plant has only minute pea-like swellings to its roots. H. H. J.

Photo: Ross, Whitby.

A GROUP OF CHOWS.

The chow is very much like what the primitive type of domesticated dog must have been.

Continued from page 418.

LANGUAGES:

Contributors:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A. [Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).

LATIN.—XVI

Irregular Verbs (*Continued*).

III. Fero, *I bear, I carry*

ACTIVE VOICE

Chief Parts:—**fĕrō, tŭli, lātum, ferrĕ**

Indicative Mood

PRESENT	IMPERFECT	FUTURE
fĕrō	fĕrēbam	fĕr-am
fers	fĕrēbās	fĕr-ēs
fert	fĕrēbăt	fĕr-ĕt
fĕrĭmŭs	fĕrēbāmŭs	fĕr-ēmŭs
fĕrtĭs	fĕrēbātĭs	fĕr-ētĭs
fĕrunt	fĕrēbant	fĕr-ent

PERFECT	PLUPERFECT	FUTURE-PERFECT
tul-i, etc.	tŭl-ĕram, etc.	tŭl-ĕrō

Subjunctive Mood

PRESENT	IMPERFECT
fĕram	ferrem
fĕrās	ferrēs
fĕrăt	ferrĕt
fĕrāmŭs	ferrēmŭs
fĕrātĭs	ferrētĭs
fĕrant	ferrent

PERFECT	PLUPERFECT
tŭl-ĕram, etc.	tŭl-issem, etc.

Imperative Mood

PRESENT	FUTURE
fĕr, fertĕ	fertō, ferto
	fertōtĕ, ferunto

Infinitive Mood

PRESENT	PERFECT	FUTURE
fer-rĕ	tŭl-issĕ	latur-ŭs essĕ

Participles

PRESENT	FUTURE
fĕrens, fĕrentĭs	lātūrŭs, -ūra, -ūrum

GERUND	SUPINE
fĕr-endum, -dī, -dō	latum, lātū

PASSIVE VOICE

Chief Parts:—**fĕrŏr, latŭs -sum, ferrī**

Indicative Mood

PRESENT	IMPERFECT	FUTURE
fĕrŏr	fĕr-ēbăr	fĕr-ăr
ferrĭs	fĕr-ēbārĭs *or* -ēbārĕ	fĕr-ērĭs *or* -ērĕ
fertŭr	fĕr-ēbātŭr	fĕr-ētŭr
fĕrĭmŭr	fĕr-ēbāmŭr	fĕr-ēmŭr
fĕrĭmĭnī	fĕr-ēbāmĭnī	fĕr-ēmĭnī
fĕruntŭr	fĕr-ēbantŭr	fĕr-entŭr

PERFECT	PLUPERFECT	FUTURE-PERFECT
ātŭs -sum, etc.	lāt-ŭs -ĕram, etc.	lāt-ŭs -ĕrō, etc.

Subjunctive Mood

PRESENT	IMPERFECT
fĕrăr	fer-rĕr
fĕrārĭs *or* -ārĕ	fer-rērĭs *or* -rērĕ
fĕrātŭr	fer-rētŭr
fĕrāmŭr	fer-rēmŭr
fĕrāmĭnī	fer-rēmĭnī
fĕrantŭr	fer-rentŭr

PERFECT	PLUPERFECT
lāt-ŭs -sim, etc.	lāt-ŭs -essem, etc.

Imperative Mood

PRESENT	FUTURE
fer-rĕ, fĕr-ĭmĭnī	fer-tŏr, fer-tŏr, fĕruntŏr

Infinitive Mood

PRESENT	PERFECT	FUTURE-PERFECT
fer-rī	lat-ŭs essĕ	lātum īrī

Participles

PERFECT	GERUNDIVE
lāt-us, lāt-ă, lāt-um	fĕr-endus, -endă, -endum

The compounds of **fero** are conjugated in the same way. The following are a few examples with their perfects and supines:—

affĕrō (ăd-),	attŭli,	allātum,	*bring*
conferō (cum-),	contŭli,	collātum,	*bring together, collect.*
differō (dĭs-),	distŭli,	dīlātum,	*separate.*
offĕrō (ŏb-),	obtŭli,	oblātum,	*offer.*

IV. Eo, *I go*

ACTIVE VOICE

Chief Parts :—**ĕō, īvī, ītum, īrĕ**

Indicative Mood

PRESENT	IMPERFECT	FUTURE
ĕō	ībam	ībō
īs	ībās	ībĭs
ĭt	ībăt	ībĭt
ĭmŭs	ībāmŭs	ībĭmŭs
ītĭs	ībātĭs	ībĭtĭs
ĕunt	ībant	ībunt

PERFECT	PLUPERFECT	FUTURE-PERFECT
īvī *or* ĭī	īvĕram *or* ĭĕram,	īvĕrō *or* ĭĕrō,
īvistī, ĭistī, *or* istī	etc.	etc.
īvĭt, ĭĭt, *or* ĭt		
īvĭmŭs *or* ĭĭmŭs		
īvistĭs, ĭistĭs, *or* istĭs		
īvērunt, ĭērunt,		
īvērĕ, *or* ĭērĕ		

Subjunctive Mood

PRESENT	IMPERFECT
ĕam	īrem
ĕās	īrēs
ĕās	īrĕt
ĕāmŭs	īrēmŭs
ĕātĭs	īrētĭs
ĕant	īrent

PERFECT	PLUPERFECT
īvĕrim *or* ĭĕrim, etc.	īvissem, ĭissem, *or* issem, etc.

Imperative Mood

PRESENT	FUTURE
ī, ītĕ	ītō, ītō
	ītōtĕ ĕuntō

Infinitive Mood

PRESENT	PERFECT	FUTURE
īrĕ	īvissĕ, ĭissĕ, *or* issĕ	ītūrŭs essĕ

Participles

PRESENT	FUTURE
ĭens, ĕuntĭs	ĭturŭs, ĭtură, ĭturum

GERUND	SUPINE
ĕundum, -di, -dō	ĭtum, ītū

PASSIVE VOICE (IMPERSONAL)

Indicative Mood

PRESENT	PERFECT
ītŭr	ĭtum est
IMPERFECT	PLUPERFECT
ībātŭr	ĭtum ĕrăt
FUTURE	FUTURE-PERFECT
ībĭtŭr	ĭtum ĕrĭt

Subjunctive Mood

PRESENT	PERFECT
ĕātŭr	ĭtum sĭt
IMPERFECT	PLUPERFECT
īrētŭr	ĭtum essĕt

Infinitive Mood

PRESENT

īrī

The compounds of **ĕō** are conjugated in the same way, usually taking -**ĭī** not -**īvī** in the tenses formed from the perfect base.

ăbĕō (ăb-)	ăbĭī	ăbĭtum	*go away*
ădĕō (ăd-)	ădĭī	ădĭtum	*approach*
ĭnĕō (ĭn-)	inĭī	ĭnĭtum	*enter*
intereo (intĕr-)	intĕrĭī	intĕrĭtum	*perish*
introĕō (intrō-)	introĭī	introĭtum	*go into*
pĕrĕō (pĕr-)	pĕrĭī	pĕrĭtum	*perish*
rĕdĕō (rĕ-)	rĕdĭī	rĕdĭtum	*return*
transĕō (trans-)	transĭī	transĭtum	*cross*

ambĭō, *I go about*, retains the *i* throughout, and is conjugated like a regular verb of the fourth conjugation.

V. quĕo, *I am able*, and nĕquĕō, *I am unable.*

Chief Parts :—

quĕō, quīvī, quītum, quīrĕ ;
nĕquĕō, nĕquīvī, nĕquītum, nĕquīrĕ.

These two verbs which have no imperative and no gerund, are conjugated like ĕō.

In the present indicative **nōn quīs** and **nōn quĭt** are used instead of **nĕquīs** and **nĕquĭt.** The shorter forms (omitting **v**) are used indifferently with the longer forms (retaining **v**) in the tenses derived from the perfect base, but not in the first person singular or plural of the perfect indicative, where only the longer forms occur.

VI. Edō, *I eat*

Chief Parts :—**ēdō, ēdī, ēsum, ēdĕrĕ** or **essĕ,** is regular in its conjugation, except in the following tenses :—

ACTIVE VOICE

Indicative Mood

PRESENT	IMPERFECT	PLUPERFECT
ēdō	ēdēbam, etc.	ēdĕram, etc.
ēdĭs *or* ēs	*Future*	*Future-Perfect*
ēdĭt *or* est	ēdam, etc.	ēdĕrō, etc.
ēdĭmŭs	*Perfect*	
ēdĭtĭs *or* estĭs	ēdī, etc.	
ēdunt		

Subjunctive Mood

PRESENT	IMPERFECT
ēdam *or* ēdim	ēdĕram *or* essem
ēdās *or* ēdis	ēdĕrēs *or* essēs
ēdăt *or* ēdĭt	ēdĕrĕt *or* essĕt
ēdāmŭs *or* ēdīmŭs	ēdĕrēmŭs *or* essēmŭs
ēdātĭs *or* ēdītĭs	ēdĕrētĭs *or* essētĭs
ēdant *or* ēdint	ēdĕrent *or* essent

PERFECT	PLUPERFECT
ēdĕrim, etc.	ēdissem

Imperative Mood

PRESENT	FUTURE
ēdĕ *or* ēs	ēdĭtō *or* estō
ēdĭtĕ *or* estĕ	ēdĭtō *or* estō
	ēdĭtōtĕ *or* estōtĕ
	ēduntō

Infinitive Mood

PRESENT	PERFECT	FUTURE
ēdĭrĕ *or* -essĕ	ēdissĕ	ēsūrŭs essĕ

Exercise 15

Translate into English:

1. Non cuivis homini contingit adire Corinthum. 2. Nec deus intersit nisi dignus vindice nodus. 3. Nil actum credens dum quid superesset agendum. 4. Bis gratum est quo dato opus est ultro si offeras. 5. Bonis nocet si quis malis pepercerit. 6. Huic quia bonae artes desunt, dolis atque fallaciis contendit.

Translate into Latin:

1. Terror-stricken, some fled (were borne) to one part, some to another. 2. They were unable to bring help to their men. 3. He was desirous also of visiting the cities of the Greeks. 4. A suppliant, he visited the altars of the gods. 5. Most wretched is he who when he desires to eat has nothing to eat. 6. The Meander discharges itself into the bosom of the sea.

Key to Exercise 14

1. The times change, and we are changed with them. 2. It gains strength as it goes. 3. The man is wise who speaks little. 4. The rest are lacking. 5. I am what you will be, I was what you may be. 6. The public wishes to be fooled. 7. Not to advance is to recede. 8. He conquers who endures.

1. Valeat quantum valere potest. 2. Aut prodesse volunt aut delectare poetae. 3. Morituri te salutamus. 4. Vox audita perit, litera scripta manet. 5. Sine vitiis nemo nascitur. 6. Si vis pacem, para bellum. 7. Veritas filia temporis dicitur. 8. Curae leves loquuntur, ingentes stupent. E. A. B.

FRENCH.—XVI

Passive Verbs.—Active verbs may be turned to passive. In English this is done by conjugating the principal verb in the past participle with the verb *to be*; thus *the son loves the mother* may be changed to *the mother is loved by the son*. Similarly, in French, **le fils aime la mère** becomes **la mère est aimée par le fils.**

Passive verb **être aimé**, *to be loved.*

Indicative Mood

PRESENT

je suis, tu es } aimé *or* aimée, *I am loved.*

il est aimé.
elle est aimée.
nous sommes, vous êtes } aimés *or* aimées.
ils sont aimés.
elles sont aimées.

PAST INDEFINITE

j'ai été, tu as été } aimé *or* aimée, *I have been loved.*

il a été aimé.
elle a été aimée.
nous avons été, vous avez été } aimés *or* aimées.
ils ont éte aimés.
elles ont été aimées.

IMPERFECT

j'étais, tu étais } aimé *or* aimée, *I was loved.*

il était aimé.
elle était aimée.
nous étions, vous étiez } aimés *or* aimées.
ils étaient aimés.
elles étaient aimées.

PLUPERFECT

j'avais été, tu avais été } aimé *or* aimée, *I had been loved.*

il avait été aimé.
elle avait été aimée.
nous avions été, vous aviez été } aimés *or* aimées
ils avaient été aimés.
elles avaient été aimées.

PAST DEFINITE

je fus, tu fus } aimé *or* aimée, *I was loved.*

il fut aimé.
elle fut aimée.
nous fûmes, vous fûtes } aimés *or* aimées.
ils furent aimés.
elles furent aimées.

PAST ANTERIOR

j'eus été, tu eus été } aimé *or* aimée, *I had been loved.*

il eut été aimé.
elle eut été aimée.
nous eûmes été, vous eûtes été } aimés *or* aimées.
ils eurent été aimés.
elles eurent été aimées.

FUTURE

je serai, tu seras } aimé *or* aimée, *I shall be loved.*

il sera aimé.
elle sera aimée.
nous serons, vous serez } aimée *or* aimées.
ils seront aimés.
elles seront aimées.

FUTURE ANTERIOR

j'aurai été, tu auras été } aimé *or* aimée, *I shall have been loved.*

il aura été aimé.
elle aura été aimée.
nous aurons été, vous aurez été } aimés *or* aimées
ils auront été aimés.
elles auront été aimées.

Conditional Mood

PRESENT

je serais, tu serais } aimé *or* aimée *I should be loved.*

il serait aimé.
elle serait aimée.
nous serions, vous seriez } aimés *or* aimées.
ils seraient aimés.
elles seraient aimées.

PAST

j'aurais été, tu aurais été } aimé *or* aimée, *I should have been loved.*

il aurait été aimé.
elle aurait été aimée.
nous aurions été, vous auriez été } aimés *or* aimées
ils auraient été aimés.
elles auraient été aimées.

Imperative Mood

sois aimé *or* aimée, *be* (thou) loved.
qu'il soit aimé.
qu'elle soit aimée.
soyons, soyez } aimés *or* aimées.
qu'ils soient aimés.
qu'elles soient aimées.

Subjunctive Mood

PRESENT

que je sois, que tu sois } aimé *or* aimée, *that I may be loved.*

qu'il soit aimé.
qu'elle soit aimée
que nous soyons, que vous soyez } aimés *or* aimées
qu'ils soient aimés.
qu'elles soient aimées.

PERFECT

que j'aie été, que tu aies été } aimé *or* aimée, *that I may have been loved.*

qu'il ait été aimé.
qu'elle ait été aimée
que nous ayons été, que vous ayez été } aimés *or* aimées
qu'ils aient été aimés.
qu'elles aient été aimées.

IMPERFECT		PLUPERFECT	
que je fusse que tu fusses	aimé *or* aimée, *that I might be loved.*	que j'eusse été que tu eusses été	aimé *or* aimée, *that I might have been loved.*
qu'il fût aimé. qu'elle fût aimée.		qu'il eût été aimé. qu'elle eût été aimée.	
que nous fussions que vous fussiez	aimés *or* aimées.	que nous eussions été que vous eussiez été	aimés *or* aimées
qu'ils fussent aimés. qu'elles fussent aimées		qu'ils eussent été aimés qu'elles eussent été aimés	

Infinitive Mood

PRESENT	PAST INDEFINITE
etre aimé or aimée, *to be loved*	avoir été aimé *or* aimée, *to have been loved.*
PRESENT PARTICIPLE	PERFECT PARTICIPLE
étant aimé *or* aimée, *being loved*	ayant été aime *or* aimée *having been loved.*

There is only one conjugation of passive verbs, consisting as above of the auxiliary verb **être** conjugated with the past participle, which always agrees in gender and number with the subject of the verb, thus—

Ces vieillards sont respectés.	*Those old men are respected.*
Ces filles sont aimées par tout le monde.	*Those girls are loved by everybody.*

The genius of the French language prefers the active to the passive voice, which is comparatively seldom used. The commonest mode of avoiding it is the use of the indefinite pronoun **on**, as in—

On dit que cela est ainsi.	*It is said that this is so.*

The reflexive is also used, and other forms of the active, as follows :—

Cet homme se trompe.	*That man is mistaken.*
Ma sœur est à plaindre.	*My sister is to be pitied.*

In answers to questions the pronoun **le** is often used to represent the complement of the verb.

Ces enfants sont-ils aimés ?	*Are these children loved ?*
Ils ne le sont pas.	*They are not.*
Êtes-vous la sœur de mon ami ?	*Are you my friend's sister ?*
Je la suis.	*I am (she).*

VOCABULARY

l'auteur (m.), *the author.*
le bras, *the arm.*
comment, *how.*
la conduite, *conduct.*
juste, *rightly, correctly.*
louer, *to let.*
le monde, *the world, society.*
le coup, *the blow.*
l'église (f.), *the church.*
l'entrée, the *entrance.*
estimer, *to esteem.*
l'être, *the being.*
fier, *proud.*
la fierté, *pride.*
un obstacle, *an obstacle.*
punir, *to punish.*
quelquefois, *sometimes.*
rarement, *seldom.*
le relieur, *the bookbinder.*
le service, *the service.*
user, *to wear out.*

Exercise 29

1. Ils ne l'avaient jamais assez bien vue pour la reconnaître. 2. Elle avait toujours eu cette fierté des êtres très fiers. 3. Sa beauté n'eût pas été un obstacle à son entrée dans le service de la comtesse. 4. Elles n'avaient pas lu "le Mariage de Figaro." 5. Votre main avait dû sentir le coup. 6. Il avait vu juste. 7. Elle avait fermé les yeux. 8. Il l'aurait fait aussitôt, s'il n'avait pas eu sa femme au bras. 9. Je l'ai donc interrogée. 10. Leur conduite est-elle approuvée ? 11. Elle n'est approuvée de personne. 12. Cette dame est-elle estimée et approuvée ? 13. Elle n'est ni estimée ni approuvée.

Exercise 30

1. Are you the mistress of the house ? 2. I am (she). 3. Is your mother loved by your sister ? 4. She is loved by her brother and sister. 5. Are the Italians liked by the French ? 6. Are not your school-children blamed ? 7. They are blamed sometimes. 8. Are they often punished ? 9. They are seldom punished. 10. By whom are you punished when you are idle ? 11. I am never punished. 12. Has his conduct been approved ? 13. It has been approved by every one. 14. Is that author esteemed ?

Key to Exercise 27

1. This hamlet is not far from the town where you were doctor. 2. These rumours were believed false. 3. All that is over. 4. He has left us a book on medicine. 5. To which of the two ought I to give this money ? 6. They would have liked to see him from near at hand. 7. You have often spoken to us. 8. I have not seen him yet. 9. Have you not said anything to my cousin ? 10. I have not said anything to him. 11. What have you finished to-day ? 12. We did not work yesterday. 13. Have you often spoken to him about it ? 14. I have often spoken to him about it. 15. Who told you that ? 16. The barrister told me. 17. Have you seen him lately ? 18. Have you not taken off your gloves and shoes ? 19. I have not taken my gloves off, but I have taken off my hat. 20. Have you not told him that I am here ? 21. I have not told him yet.

Key to Exercise 28

1. Vos neveux nous ont parlé. 2. Le cordonnier a ôté ses souliers. 3. N'avez-vous rien dit à mon cousin ? 4. Je ne l'ai jamais rencontré. 5. Je leur en ai souvent parlé. 6. N'avez-vous pas assez écrit ? 7. N'avez-vous pas travaillé hier ? 8. Nous avons lu et travaillé toute la journée. 9. Le tailleur n'a-t-il pas mis son chapeau ? 10. Qu'avez vous dit à ce petit garçon ? 11. Je ne lui ai rien dit. 12. Qu'avez-vous étudié ce matin ? 13. Nous avons étudié nos leçons et nous avons lu nos livres. 14. Le jardinier du ministre a-t-il planté le poirier ? 15. Avez-vous acheté un habit de drap noir ? 16. Nous avons mis nos souliers et nos bas. 17. N'aviez-vous pas eu besoin de moi ? 18. N'aviez-vous pas eu l'intention de me parler ? 19. Dès que vous eûtes fini votre lettre, ne la portâtes-vous à la poste ? 20. Dès que vous futes arrivé, ne commençâtes-vous pas à écrire ?

E. A. B.

GERMAN.—XIII

Numerals.—Ein is the only cardinal that is fully inflected. When used as an adjective, and qualifying a noun which is expressed, it is declined in the same way when used as a numeral as it is when used as the indef. art., unless it is preceded by some qualifying word. Ein Mann is either *one man* or *a man*.

When preceded by some limiting word (usually the def. art. or a demons. adj.) it is declined as any other adjective would be in like circumstances. Der eine ſagte ja, der andere nein, *the one said yes, the other no.* Ich habe nur das eine Kind geſehen, *I only saw* (the) *one child.* In the plural (only used without a noun) it is die einen. Die einen waren zufrieden, die anderen unzufrieden, *some were satisfied, others were dissatisfied.*

Similarly we can say dieſes eine Kind, *this one child ;* mit ſeinem einen Arm, *with his one arm.*

In counting the contracted form of the neuter eins (for eines) is used. Noch ein and noch eins are used for *one more, another.* Geben Sie mir noch eins, *give me another.* Ich möchte noch eine Taſſe Tee haben, *I should like to have another cup of tea.* But when *another* is used in the sense of *one in the place of what you have,* it must be translated by ein ander. Ich will ein anderes Buch haben, *I want to have another book* (in place of the one I have).

When used absolutely or pronominally ein is declined like dies, but the neuter sing. is contracted to eins; er erzählte uns eine intereſſante Geſchichte und dann erzählte ſie auch eine, *he told us an interesting story and then she also told one;* Ich habe einen von ihnen geſehen, *I saw one of them ;* Eins der Gläſer war kaput, *one of the glasses was broken.*

In order to distinguish between ein used as an indef. art. and ein used as a numeral, it is sufficient, in speaking, to emphasise the word in the latter case. In printing, the distinction is made in various ways : ein the numeral is (*a*) written with a capital, Ein ; (*b*) written with an accent on the e, éin ; or (*c*) the type is spaced, e i n. The latter is the commonest way in print.

Zwei and drei are usually invariable, but in ambiguous cases they have special forms of the gen. and dat., namely, zweier, zweien and dreier, dreien. Er las uns die Briefe zweier Freunde vor, *he read out to us the letters of two friends ;* Sie ſaßen zu dreien auf jeder Bank, *they sat in threes on each bench.* Beide, *both,* is often used where we use *two.* The dat. in en is also used for other cardinals up to ten, when they are used absolutely as dreien above.

Ordinals never appear in their simple or thematic form except in compounds : zweitgrößte, *the second largest.*

Nouns : Number. — The use of the singular and plural numbers is, on the whole, much the same in German as in English ; however, there are minor differences which the student should note as he comes across them. In German we find, for instance, die Schere (sing.) for English *scissors* (plur.) ; and again, die Koſten (plur.) for *the cost* (sing.).

Masculine nouns of measure are used in the singular after a numeral : zehn Fuß hoch, *ten feet high ;* drei Zoll lang, *three inches long ;* ſechs Faß Wein, *six casks of wine ;* zwei Pfund Zucker, *two pounds of sugar.* Mann is similarly used in the singular when we are speaking of large bodies of men ; zwei tauſend Mann, *two thousand men.* But feminines like Elle, *ell,* and Meile, *mile* are used in the plural ; Zwei Ellen Seide, *two ells of silk,* drei Meilen lang, *three miles long.*

A good many abstract nouns are only used in the singular though their English equivalents are sometimes used in the plural. Such are das Glück, *happiness,* die Angſt, *fear, anxiety,* and so on.

When speaking of a number of individuals with reference to a single thing which they each possess, the singular is used in German, the plural in English : Sie nickten mit dem Kopfe, *they nodded their heads* (with the head) ; Die Hunde hatten kein Haar am Schwanz, *the dogs had no hair on their tails.*

A number of nouns have double forms of the plural with different meanings. The following are the commonest. They all belong to the strong declension :

das Band, Bänder, *ribbons;*	Bande, *bonds, fetters.*
die Bank, Bänke, *benches ;*	Banken, *banks* (commercial).
das Geſicht, Geſichter, *faces ;*	Geſichte, *sights, apparitions.*
das Horn, Hörner, *horns ;*	Horne, *kinds of horn.*
der Laden, Läden, *shops ;*	Laden, *shutters.*
das Land, Länder, *countries ;*	Lande, *dominions* (as die Niederlande, *the Netherlands*).
der Mann, Männer, *individual men ;*	Mannen, *vassals.*
der Strauß, Sträuße, *nosegays ;*	Strauße or Sträußen, *ostriches.*
das Tuch, Tücher, *cloths, shawls ;*	Tuche, *kinds of material.*
das Wort, Wörter, *separate words ;*	Worte, *connected words.*

The plural Männer is used for *men* considered individually or in contradistinction to women. Collectively and in the sense of people Mann takes the plural Leute. Most compounds of Mann take the plural Leute, e.g. Kaufmann, *merchant*, Kaufleute. But some take Männer, e.g. Ehrenmann, *man of honour*, Ehrenmänner.

The student should note the following: Ehemänner, *husbands*, Eheleute, *married people*.

A number of nouns, chiefly abstract, and many of them derived from verbs, have slightly irregular plurals. The commonest are as follows:

der Bau, *building ;*	Bauten, *buildings.*
das Beſtreben, *effort, striving ;*	Beſtrebungen, *efforts.*
der Betrug, *deceit ;*	Betrügereien, *frauds.*
der Bund, *league, society ;*	Bündniſſe, *leagues.*
der Dank, *thanks ;*	Dankſagungen, *expressions of thanks.*
das Erbe, *inheritance ;*	Erbſchaften, *inheritances.*
die Gewalt, *violence ;*	Gewaltaten, *deeds of violence.*
das Glück, *luck ;*	Glücksfälle, *strokes of luck.*
die Liebe, *love ;*	Liebſchaften, *love affairs.*
das Lob, *praise ;*	Lobſprüche, *panegyrics.*
der Rat, *counsel ;*	Ratſchläge, *counsels* (but Räte, *counsellors*).
der Streit, *quarrel ;*	Streitigkeiten, *quarrels.*
der Tod, *death ;*	Todesfälle, *deaths.*
der Zank, *quarrel ;*	Zänkereien, *quarrels.*

Most of these plurals have corresponding regular singulars.

Nouns with Double Genders. — The following have different meanings according to their genders. In the list given below the plural is placed in brackets after the noun:

der Band (Bände), *volume ;* das Band (Bänder), *ribbons,* (Bande), *bonds.*
der Bauer (Bauern), *peasant ;* das or der Bauer (Bauer), *cage.*
der Chor (Chöre), *body of singers ;* das Chor, *choir* (of a church).
der Erbe (Erben), *heir ;* das Erbe, *inheritance.*
der Heide (Heiden), *heathen ;* die Heide (Heiden), *heath.*
der Hut (Hüte), *hat ;* die Hut, *guard, heed.*
der Kunde (Kunden), *customer ;* die Kunde (Kunden), *news, information.*
der Leiter (Leiter), *leader ;* die Leiter (Leitern), *ladder.*
der Meſſer (Meſſer), *the measurer ;* das Meſſer (Meſſer), *knife.*
der Reis, *rice ;* das Reis (Reiſer), *twig.*
der Schild (Schilde), *shield ;* das Schild (Schilder), *signboard.*
der See (Seen), *lake ;* die See, *ocean.*
die Steuer (Steuern), *tax ;* das Steuer (Steuer), *helm.*
der Tor (Toren), *fool ;* das Tor (Tore), *gate.*

VOCABULARY

Gewandhaus, s.n.3, *cloth-makers' hall.*
Symphonie, w.f., *symphony.*
berauſchen, w., *intoxicate.*
Harmonie, w.f., *harmony.*
hinuntereilen, w., *to hasten down.*
Regen, s.m.1, *rain.*
lauwarm, *lukewarm.*
Frühling, s.m.2, *spring.*
Meiſter, s.m.1, *master.*
Zeitgenoſſe, *w.m., contemporary.*
leben, w., *to live.*
Gedanke, w.m., *thought.*
Wien, *Vienna.*
erkennen, w., *to recognise.*
Aufſchrift, w.f., *superscription.*
lange, *for a long time.*
finden, s.1*a*, f., *to find.*
Kaiſerſtadt, s.f.2, *imperial city.*
Johannes, *John.*
Muſikant, w.m., *musician.*
entſcheiden, s.3*b*, *to decide.*
Roß, s.n.2, *steed.*
Mähne, w.f., *mane.*
laufen, s.2*d*, *to run.*
jagen, w., *to hunt, pursue.*
Freiheit, w.f., *freedom.*
trällern, w., *to sing.*
hinunterrollen, w., *to roll down.*
Eilwagen, s.m.1, *mail coach.*
Böhmen, *Bohemia.*
Frühlingslerche, w.f., *lark of spring.*
Kamin, s.m.,2, *fireplace chimney.*
Mal, s.n.2, *time.*
moll, *minor.*
Strom, s.m.2, *stream.*
brauſen, w., *to rush, roar.*
achten, w., *to notice, pay attention to.*
nahen, w., *to approach.*
ankündigen, w., *to announce.*
Ton, s.m.2, *sound.*
Troſt, s.m., *comfort.*
drücken, w., *to press.*
einſam, *lonely.*
rufen, s.2*d*, *c*, *to call.*
Siegel, s.m.1, *seal.*
reiſeluſtig, *fond of travel.*
erbrechen, s.1*c*, *to break open.*
es giebt, *there is, there are.*
vagabundieren, w., *to roam.*
Zuruf, s.m.2, *call, summons.*
entſchließen, s.3*c*, *to resolve.*
fliegen, s.3*c*, *to fly.*
Wette, w.f., *wager.*
necken, w., *to tease.*
gebrauchen, w., *to make use of.*
ausrufen, s.2*d*, *to exclaim.*
prächtig, *splendid.*
Cabriolet, s.n.2, *cabriolet.*
blau, *blue.*
ſchmettern, w., *to warble.*
Kohlmarkt, s.m.2, *vegetable market.*

Exercise 33

Ich hatte auf dem Gewandhaus[1] in Leipzig zum erſten Male die fünfte große Symphonie, aus C moll[2], von Ludwig van Beethoven, gehört. Noch berauſcht von dieſem Strome der Harmonie, welcher durch meine ganze Seele gebrauſt[3] war, eilte ich die Straße hinunter, ohne[4] den Regen zu achten, mit welchem der Monat März lauwarm den nahenden Frühling ankündigte. „Und dieſer große Meiſter der Töne iſt mein Zeitgenoſſe!" ſprach ich, „und ich[5] ſollte nicht den Troſt haben, die Hand des Lebenden mit Dankſagung zu drücken?" Mit dieſem Gedanken trat ich in mein einſames Zimmer. „Ein Brief aus Wien," rief mein Diener. Ich erkannte[6] an Siegel[7] und Aufſchrift[7], daß er von meinem reiſeluſtigen Freunde Robert kam, von dem ich lange Nichts[8] gehört hatte. Ich erbrach den Brief und fand darin nur die Worte:

„'S giebt nur eine Kaiſerſtadt,
'S giebt nur ein Wien."

Johannes, unſer vagabundierender Muſikant, iſt auch da. Komm'[9] doch."

Nichts weiter im ganzen Briefe, aber dieſer Zuruf entſchied[10] über mich. Noch war ich jung, freudig, ſchnell und entſchloſſen, noch war ich ein freies Roß, das mit fliegender Mähne Wette[11] läuft mit dem Winde, und neckend die Vögel jagt, und ich gebrauchte meine Freiheit. „Zwei Freunde und Beethoven dazu[12] in Wien" rief ich aus, und das Lied weiter[13] trällernd:

„O das muß prächtig ſein
Da möcht' ich hin[14]",

rollte ich ſchon am dritten Tage darauf[15] im Cabriolette auf dem Eilwagen in das blaue Böhmen hinunter, vor[16] mir in grauen Märzhimmel ſchmetternd die erſte Frühlingslerche, weiter[17] und weiter, bis ich endlich am Kohlmarkte in Wien bei[18] meinen beiden Freunden Abends[19] am Kamin ſaß.

Julius Moſen.

NOTES:

(1) Gewandhaus, a famous concert hall in Leipzig. (2) aus C moll, in C minor. (3) gebrauſt, conjugated with ſein, as it is looked upon as a verb of movement from place to place. (4) ohne—prepositions are followed by the infinitive with zu. (5) ich ſollte . . . drücken? a negative question in which the order is often not inverted. (6) erkennen is followed by the preposition an. (7) Siegel, Aufſchrift, note that these nouns are used without an article. (8) 'S, stands for es. —these are the first two lines of a popular song of which the next two are found later on in the extract; the language is colloquial. (9) komm', imperative for komme. The doch adds emphasis, *do come*. (10) entſcheiden über, to decide about. (11) Wette laufen, usually wettlaufen. (12) dazu, into the bargain. (13) weiter trällern, to continue to sing. (14) ich möchte dahin, the verb of going is omitted, I should like to go there. (15) darauf, in expressions of time means after, following; der Tag darauf, the day after. (16) vor . . . Frühlingslerche, an absolute participial construction. (17) weiter und weiter, on and on. (18) bei, is the preposition used to indicate that one is in the company of other people. (19) Abends, the genitive is like our of an evening. When referring to a single time it means in the evening.

VOCABULARY

yet, jedoch.
character, Charakter, s.m.2.
able, tüchtig.
human, menſchlich.
rarely, ſelten.
false, falſch.
mankind, Menſch, w.m. (use in plur.).
error, Fehler, s.m.1.
rash, vorſchnell.
in, in, gov. acc.
integrity, Redlichkeit, w.f.
take place, vorkommen, s.2*d* (sep.).
system, Syſtem (zistáym), s.n.2.
Louis, Ludwig.
assume, annehmen, s.1*c* (sep.)
undoubting, zweifelfrei.
overreach, überliſten, w. (insep).
conduct, Benehmen, s.n.1.
artful, liſtig.
monarch, Fürſt, w.m.
nature, Natur, w.f.
uniform, einförmig.
insincere, unaufrichtig.
some, einige.
arise from, entſpringen, s.2*a*, gov. dat. conjugated with ſein.
confidence, Vertrauen, s.n.1.
honour, Ehrenhaftigkeit, w.f.
when, wenn.
over-refined, überfein.
policy, Politik, f.
induce, veranlaſſen, s.2*c* (insep.).
appearance, Schein, s.m.2.
object, Beſtreben, s.n.1.
general, allgemein.
as . . . as, ſo . . . wie.
suspicious, argwöhniſch.
jealous, eiferſüchtig.
any, irgend ein.
ever, jemals.
contradiction, Widerſpruch, s.m.2.
tyrant, Tyrann, w.m.
breathe (here live), leben, w.

Exercise 34

Yet[1] there were contradictions in the character of this artful and able monarch, for human[3] nature is rarely uniform. Himself[2] the most false and insincere of mankind, some[4] of the greatest errors of his life arose from too rash[5] a confidence in the honour and integrity of others. When these errors took place, they seem[4] to have arisen from an over-refined system of policy, which induced Louis to assume the appearance of undoubting[6] confidence in those whom it was his object to overreach[7]; for, in his general conduct, he was[4] as jealous and suspicious as any tyrant who ever breathed.

NOTES:

(1) *Yet there were*, es waren jedoch. (2) Translate *although* (obgleich) *he himself was the most*. (3) *Human nature*, use the def. art. (4) Remember to invert the order because the sentence does not begin with the subject. (5) Order, *a too rash*. (6) Insert the indef. art. before *undoubting*. (7) Order, *whom to overreach his object was*.

Key to Exercise 31

DISCOVERY OF AMERICA

At about two o'clock after midnight the exultant shout of joy, "Land! Land!" was heard to resound from the *Pinta*, which was always on ahead, and at this a shudder of gladness (a glad shudder) darted through all hearts. How gladly the ship's company would have given themselves up at once to the most unrestrained joy; but they had been so often disappointed in their expectations that it was impossible for them to suppress the anxious doubts which mingled with their joy. Amid fear and hope, therefore, they awaited the break of day, in order to be convinced by their own eyes that the fulfilment of their most ardent wish had not been a dream.

Slowly, as they pass for a sleepless patient, the remaining hours of the night passed by for these men (them). Every minute seemed to them an hour, every hour a whole long day. At last, after long waiting and hoping, the eastern sky began to shimmer a little. Now the lovely flush of dawn appeared . . . And the men of the two remaining ships, too, raised their voices in a general and touching hymn of praise. For the land which they had so ardently longed to discover now lay before their eyes.

Key to Exercise 32

Seelengröße.

Alexander der Große, König von Macedonien, als er Darius, König von Perſien beſiegt hatte, nahm eine unendliche Zahl von Menſchen gefangen, und unter anderen die Frau und die Mutter von Darius. Nach den Kriegsgeſetzen hätte er ſie zu Sklaven machen können; aber er hatte zu viel Seelengröße um einen ſchlechten Gebrauch von ſeinem Siege zu machen; er behandelte ſie alſo als Königinnen, und erwies ihnen dieſelbe Aufmerkſamkeit und dieſelbe Rückſicht als ob er ihr Untertan geweſen wäre. Als Darius dies hörte, ſagte er daß Alexander verdiente ſiegreich zu ſein, und daß er allein würdig ſei an ſeiner Stelle zu regieren. Merke hieran wie Tugend und Seelengröße ſelbſt Feinde dazu zwingen Lob zu ſpenden.

M. A. L.

RUSSIAN.—VI

The Noun

38.—*The Prepositional Singular.*

The following are the endings of this case:

Masculine: **ѣ**, **ѣ**, **ѣ**, instead of ъ, й, ь, in Nominative, respectively.

Feminine: **ѣ**, **ѣ**, **и**, instead of а, я, ь, in Nominative, respectively.

Neuter: **ѣ**, **ѣ**, instead of о, **е**, in Nominative, respectively. (See Rule 1.)

Examples

О фабрика́нтѣ,	*about the manufacturer.*
При това́рѣ,	*near (or at) the goods.*
О казначе́ѣ,	*about the treasurer.*
Въ сара́ѣ,	*in the stable, shed.*

39. The Prepositions governing this case are:

(*a*) Въ, *in;* На, *on;* При, *at, close to, near by.*
(*b*) О, объ, *of, about* (= concerning).
(*c*) По, *after* (in answer to question: *When?*).

Some masculine nouns have a dative ending in the prepositional case with the accent always on the last syllable.

Examples

Nominative	*Prepositional*
Лѣсъ, *the forest.*	Въ Лѣсу́, *in the forest.*
Годъ, *the year.*	Въ году́, *in the year.*
Полъ, *the floor.*	На полу́, *on the floor.*
Верхъ, *the top.*	На верху́, *on the top.*

Practice XVI

Form the prepositional of the following nouns with a preceding preposition as given in the Rule 39:

Го́родъ, *the town.*	Направле́ніе, *the direction.*
Край, *the district.*	По́лка, *a shelf.*
Ште́мпель (m.), *the stamp.*	Ви́шня, *a cherry.*
Ка́дмій, *cadmium.*	Горсть (f.), *a handful.*

The Verb

The Laws of Permutation and the Second Conjugation.

42. Verbs ending with -жить, -чить, -шить, and -щить follow the Rule 23. However, the **ю** of the First Singular and the **-ять** of the Third Plural are replaced by **-у** and **-ать**, respectively, as exemplified in Table B.

TABLE B.

Infinitive *English*	Служи́ть *To serve*	Учи́ть *To teach*	Смѣши́ть *To make one laugh*	Таши́ть *To pull, draw, drag*
Я	Служу́	Учу́	Смѣшу́	Тащу́
Ты	Слу́жишь	У́чишь	Смѣшишь	Та́шишь
Онъ, она́, оно́	Слу́житъ	У́читъ	Смѣшитъ	Та́щитъ
Мы	Слу́жимъ	У́чимъ	Смѣшимъ	Та́щимъ
Вы	Слу́жите	У́чите	Смѣшите	Та́щите
Они́, онѣ, они́	Слу́жатъ	У́чатъ	Смѣшатъ	Та́щатъ

43. The Verbs ending in the Infinitive with -дить, -зить, -сить, -тить, and -стить, also follow Rule 23, but they have in the First Singular, -жу, -жу, -шу, -чу, and -шу, respectively, as is shown in Table C.

44. The Verbs стоя́ть, *to stand*, and сто́ить,

TABLE C.

Group:—	1	2	3	4	5
Infinitive *English*	Ходи́ть *To go, attend*	Грузи́ть *To load*	Проси́ть *To ask*	По́ртить *To spoil*	Чи́стить *To clean*
Я	Хожу́	Гружу́	Прошу́	По́рчу	Чи́щу
Ты	Хо́дишь	Гру́зишь	Про́сишь	По́ртишь	Чи́стишь
Онъ, она́, оно́	Хо́дитъ	Гру́зитъ	Про́ситъ	По́ртитъ	Чи́ститъ
Мы	Хо́димъ	Гру́зимъ	Про́симъ	По́ртимъ	Чи́стимъ
Вы	Хо́дите	Гру́зите	Про́сите	По́ртите	Чи́стите
Они́, онѣ, они́	Хо́дятъ	Гру́зятъ	Про́сятъ	По́ртятъ	Чи́стятъ

41. Prepositional with Dative Endings.—

40. Influence of the Letter **і**.—Nominatives ending with -ій, -ія, or ie, end in the prepositional with **-іи**. (See Rule 16.)

Examples

Nominative	*Prepositional*
Ге́ній, *the genius.*	О ге́ніи, *about the genius.*
Ли́нія, *the line.*	На ли́ніи, *on the line.*
Положе́ніе, *the position.*	Въ положе́ніи, *in the position.*

to cost, are conjugated according to the following Table D:—

TABLE D.

Стоя́ть, *to stand*	Сто́ить, *to cost, to be worth*
Я стою́	Сто́ю
Ты стои́шь	Сто́ишь
Онъ, она, оно стои́тъ	Сто́ить
Мы стои́мъ	Сто́имъ
Вы стои́те	Сто́ите
Они, онѣ, они стоя́тъ	Сто́ятъ

Practice XVII

Conjugate the following as in Table B:

Сторожи́ть, *to watch, guard.*
Кружи́ть, *to move round.*
Точи́ть, *to turn in a lathe, grind.*
Туши́ть, *to put out* (fire), *extinguish, quell.*
Вощи́ть, *to wax, rub with wax.*

Practice XVIII

Conjugate the following as in Table C:

Находи́ть, *to find.*
Ввози́ть, *to import.*
Вывози́ть, *to export.*
Льстить, *to flatter.*
Носи́ть, *to carry, wear, bear.*
Тра́тить, *to spend, squander.*

The Imperative

45. The Imperative Singular is formed from the Second person Singular by throwing off the final **-шь**. The Letter **е** before **-шь** in the First Conjugation is changed to **й**.

	Examples 2*nd figure*	
Infinitive	*Singular*	*Imperative*
Дѣлать, *to do.*	Дѣлаешь	Дѣлай, *do.*
Торгова́ть, *to deal.*	Торгу́ешь	Торгу́й, *deal.*
Имѣть, *to have.*	Имѣешь	Имѣй, *have.*
Объясня́ть, *to explain.*	Объясня́ешь	Объясня́й, *explain.*
Говори́ть, *to speak.*	Говори́шь	Говори́, *speak.*
Люби́ть, *to love.*	Лю́бишь	Люби́, *love.*
Держа́ть, *to keep.*	Де́ржишь	Держи́, *keep.*
Сидѣть, *to sit.*	Сиди́шь	Сиди́, *sit.*
Смотрѣть, *to look.*	Смо́тришь	Смотри́, *look.*
Терпѣть, *to have patience.*	Те́рпишь	Терпи́, *have patience.*

46. The Imperative Singular for Table A is as follows: Рѣжь, плачь, пиши́, ищи́, свищи́, прячь, машь, i.e. the **е** is changed to **и**, after ш, щ, щ, of groups 3, 4, 5, and to **ь**, after ж, ч, ш, in groups 1, 2, 6 and 7.

47. The Imperative Singular of the Verbs слы́шать, ста́вить, вѣрить, мѣрить, and стоя́ть is: слышь, ставь, вѣрь, мѣрь, and стой, respectively.

48. The Imperative Plural is formed from the Imperative Singular by giving it the ending **-те**.

Examples	
Singular	*Plural*
Дѣлай	Дѣлайте
Говори́	Говори́те
Рѣжь	Рѣжьте
Пиши́	Пиши́те
Ставь	Ставьте
Вѣрь	Вѣрьте
Стой	Сто́йте

Practice XIX

Form the Imperative, Singular and Plural, from the following:

Провѣря́ть, *to check.*
Пакова́ть, *to pack.*
Проси́ть, *to ask.*
Посыла́ть, *to send.*
Отходи́ть, *to go away, to start* (a train).
Получа́ть, *to receive.*

Imperative in the Third Person

49. This is expressed by the word **пусть** (let), followed by the verb in the third person.

Examples: Пусть онъ чита́етъ, пи́шетъ, *let him read, write.*
Пусть они́ чита́ютъ, пи́шутъ, *let them read, write.*

Impersonal Forms

50. To give the verb a form of impersonality, the following means are resorted to:

(*a*) The Second Singular without the pronoun "ты."

Example: Слы́шишь шумъ, да не зна́ешь что́. *One hears a noise, but one does not know what.*

(*b*) Or the Third Singular with the addition **-ся** as a reflexive verb.

Example: Дѣлается, *it is being done.*
Слы́шится, *it is being heard.*

(*c*) Or the Third Plural without a Pronoun.

Example: Говорятъ, *they, people say.*

Prepositions Governing the Accusative

51. The prepositions (*a*) Че́резъ, *across, over, via, through, after* (of time), etc.; (*b*) Сквозь, *through*, and (*c*) Про, *of, about, for*, always require the Accusative after them.

52. The prepositions (*a*) Въ, *into, for, at;* (*b*) На, *upon, for;* (*c*) За, *behind, for;* (*d*) Подъ, *under;* and (*e*) Предъ, *before*, require the Accusative when denoting destination, space of time, or purpose, in answer to such questions as *Where to? Whither? For how long? For how much? For what?* etc.

Examples

Послáть въ Амéрику, *to send to America.*
Положúть въ шкафъ, *to put in the safe.*
Остановúться на день, *to stop for a day.*
Класть на пóлку, *to lay on the shelf.*
Дать на чай, *to give a tip* (literally, for tea).
Итти́ за гóродъ, *to go out of* (behind) *town.*
Купúть за рубль, *to buy for a rouble.*
Вознагради́ть за трудъ, *to reward for the labour.*

53. Also the prepositions о, объ, when meaning *against;* по, *up to;* съ, *like, approximately, about,* require the Accusative.

VOCABULARY

Уѣзжáть (u-yez-zhát'), *to depart.*
Обя́занность (a-byá-zan-nost'), *duty.*
Дорожúть (da-ra-zhít'), *to esteem highly, dearly.*
Вполнѣ (v-pal-nyé), *totally.*
Полага́ться (pa-la-gát'-sya), *to rely.*
Разъ (ras), *once.*
Мѣсяцъ (myé-syats), *a month.*
Дѣйствовать (dyéi-stvo-vat'), *to act.*
Находúться (na-kha-dít-sya), *to be found, situated.*
Стáнція (stán-tsi-va), *station.*
За собóю (za sa-bó-yu), *after oneself.*
Ножъ (nozh), *a knife.*
Машúна (ma-shi-na), *a machine.*
Дружúть (dru-zhít'), *to keep friendly.*
Меня́ (mye-nyá), *me.*
Васъ (vas), *you.*
Сдѣлать (sdyé-lat'), *to do.*
Одолже́ніе (a-dal-zhé-ni-ye), *a favour.*
Сказáть (ska-zát'), *to say, tell.*
Пожáлуйста (pa-zhá-lui-sta), *please.*
Этого (é-to-vo), *of this.*
Садúться (sa-dít'-sya), *to sit down.*
Спасúбо (spa-sí-bo), *thanks.*
Ему́ (ye-mú), *him.*
Ѣдетъ (yé-dyet), *goes, departs.*
Немéдленно (nye-myéd-lyen-no), *immediately.*
Москвá (ma-skvá), *Moscow.*
Книга (kní-ga), *a book.*
Шкафъ (shkaff), *a safe.*
Ликвиди́ровать (li-kvi-dí-ro-vat'), *to liquidate.*
Дѣло (dyé-lo), *the business.*

Exercise 9

Translate the following into English :—

1. Нашъ представúтель сегóдня уѣзжáетъ въ Россíю.
2. На служúтелѣ лежúтъ обя́занность дорожúть чéстью фúрмы.
3. Мы вполнѣ полага́емся на представúтеля.
4. Я служу́ въ конто́рѣ господúна Б.
5. Я хожу́ въ конто́ру ка́ждый день.
6. Я вúжу покупáтеля разъ въ мѣсяцъ.
7. Мы дѣйствуемъ въ э́томъ направле́ніи.
8. На́ша фа́брика нахóдится при стáнціи Д.
9. Вояжёръ тáщитъ за собóю мно́го багáжа
10. Я точу́ ножъ на машúнѣ.
11. Я о́чень дружу́ съ господúномъ М. Онъ меня́ у́читъ говорúть по-ру́сски.
12. Прошу́ Васъ, сдѣлайте одолже́ніе.
13. Скажúте, пожáлуйста, что стóитъ аршúнъ э́того сукнá.
14. Вы про́сите о́чень до́рого.
15. Не проси́те такъ мно́го.
16. Почему́ Вы стоúте : садúтесь, пожáлуйста.
17. Спасúбо. Я уже́ сижу́.
18. Пишúте вояжёру и скажúте ему́, пусть неме́дленно ѣдетъ въ Москву́.
19. Почему́ не де́ржите книги въ шка́фѣ ?
20. Говорятъ, что фúрма З. ликвиди́руетъ дѣло.

Exercise 10

Translate the following into Russian :—

1. Our head-salesman departs after (че́резъ) a month to Paris (Парúжъ).
2. We have two branches (отдѣле́ніе) in Paris.
3. We are sending goods to Russia via (че́резъ) Hull (Гулль).
4. Don't believe (takes Dative) his (его) tale (разска́зъ).
5. This cloth (э́то сукно́) costs very dear.
6. I stand (out) for my (за мою́) price.
7. Tell the boy not to shout. (Translate, let him not shout.)
8. We esteem highly (дорожúть) your (Ва́шимъ) order.
9. Why do you carry with (after) you (тащúть за собóю) so much luggage ?
10. Don't stand (singular). Sit down (singular) and write (singular) a letter to Mr. D.

РАЗГОВО́РЫ	CONVERSATIONS
1. Гляжу́ на Васъ и е́ле могу́ Васъ припо́мнить.	I look at you and can hardly remember you.
2. Я Вашъ ста́рый прія́тель, Давúдъ Вудъ.	I am your old friend, David Wood.
3. Ахъ, э́то Вы господúнъ Вудъ !	Ah, it's you, Mr. Wood !
4. До́бро пожа́ловать ! Садúтесь, пожа́луйста !	Be welcome ! Take a chair, please !
5. Ка́тя, принеси́ чайку́ и пирожки́ ! У насъ до́брый гость.	Kate, bring in some tea with cakes ! We have a good guest (here).
6. Ну, какъ Вамъ живётся, дружёкъ ? Разскажи́ всё подро́бно.	Well, how do you do, dear friend ? Tell everything in detail.
7. Ничего́, братъ, не могу́ жа́ловаться.	No harm, brother, I need not grumble.
8. Но Вы смо́трите тепе́рь совсѣмъ и́наче.	But you look now quite different.
9. А, ба́тенька, я про́былъ пять лѣтъ въ а́рміи.	Ah, daddy, I have spent five years in the Army.
10. Два го́да я прлежа́лъ въ транше́яхъ.	Two years I spent lying in the trenches.
11. Я былъ въ Индіи и былъ та́кже на Кавка́зѣ.	I was in India and I also was in Caucasus.
12. Ну, какъ Вамъ живётся по́слѣ войны́ ?	Well, how are you getting on after the war ?
13. Я пока́мѣсть отдыха́ю.	I am taking a rest for the while.
14. А что насчёть бу́дущности ?	And what about the future ?
15. Мой мозгъ и мои́ мы́шцы, мнѣ ещё слу́жатъ.	My brain and my muscles still serve me.

(This conversation is translated literally in order to show the Russian idiom.) A. C.

Continued from page 424.

GEOGRAPHY:

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TRADE AND TRANSPORT

To us who live in a country where we have been familiar since childhood with many convenient and speedy methods of carriage, it is hard to realise the disadvantages and difficulties which trade has to contend with in those regions where easy transport is unobtainable.

In Central Africa, for instance, in various parts of south-eastern Asia, and even in civilised countries such as Japan and China, the land carriage of goods is largely dependent upon man himself either actually acting as a porter or pushing or drawing vehicles by his own exertions. An interesting example is in the case of the carriage of tea that is introduced into Tibet from China. This is conveyed either by mules or by human porters.

The mule can travel twice as fast, but its load is only one half that of a man, who can carry over 200 pounds. These porters can cover 120 miles in twenty days over mountain passes, two of which are above 7,000 feet higher than their starting point, and along very rough tracks.

Beasts of Burden

Where the larger domestic animals are abundant these are naturally made use of to lighten the human labour, and the horse, ass, ox, reindeer, and even dogs are employed in various parts of the world. In India the Asiatic elephant is also trained to labour, and the camel is invaluable for crossing the desert tracks of North Africa owing to its power of accomplishing long journeys with very little food and without water. In Western Asia and Australia good use is also made of the camel as a beast of burden.

Animals can be used for transport in two ways. They can either be loaded with the articles to be carried like pack-horses or, a much more efficient method, can be employed to draw wheeled vehicles.

This latter method implies the making of good roads; and it is to-day rather difficult for us to realise that so bad was the state of the roads even in England, as short a time ago as a little over a hundred years, that it took two days and three nights continuous travelling to get from Manchester to Glasgow. And, further, it must be remembered that England is a country with every facility for road-making, as good material is abundant, and roads can be made in practically any direction owing to the geographical features offering but little hindrance. In other parts of the globe these advantages are frequently absent, and the height of the mountain passes, the extent of the desert and marsh, etc., render road-making if not impossible, a terribly laborious task.

Canals and Railways

It is hardly necessary to enlarge on the advantages that railways have over roads for purposes of transport. But it is interesting as affording some degree of comparison between the two methods of conveying goods, that whereas in Michigan, U.S.A., it does not pay to grow wheat at points over twenty miles from a railway, it can yet be profitably carried by rail and water from the United States of America to a European port.

The structure of the country has an even greater influence over the routes of railways than it has over those of roads, but when once constructed their greater utility has justified the expenditure of vast sums of money and much labour in making a railway route, even when the natural features of the region have opposed every kind of difficulty to the work.

Since the eighteenth century water carriage has undergone as great a revolution as land carriage. Perhaps the simplest method of water carriage is that in which rafts are allowed to drift down a river. But the use of boats for transport, both up and down stream, is very ancient, and in many parts of the world such as Russia and India, the want of roads was largely supplied by the abundance of navigable streams. Although

Photo: American Colony, Jerusalem.

CAMEL TRANSPORT IN PALESTINE.

The camel is invaluable for crossing desert tracks owing to its power of accomplishing long journeys with very little food and no water.

to-day railways have largely supplanted river transport, it is still an important means of communication, especially in undeveloped countries.

Navigable canals are another means of affording facilities for communication between different towns, and between these towns and the coast. At one time they suffered severely from competition by the railways, but it would now seem as if the extreme cheapness of transport by this means will bring them into favour once more, especially for carrying such goods as need not be delivered very quickly. And especially useful are the large ship canals such as that which will allow ocean-going steamers to land cotton from the U.S.A. in Manchester without having to be unloaded at an intermediate port and conveyed for the remainder of the distance by railway.

It is in marine navigation, however, that the most important developments have taken place. Instead of the small boats of some 100 tons burden—which was the size of the vessel in which Christopher Columbus set out to discover the New World, boats dependent upon wind for their progress—we now have the large vessels that cross the Atlantic in less than a week, and can carry very many tons of cargo.

Ocean Liners

The introduction of steam navigation has led to the shortening of ocean passages which are not, as formerly to a great extent, at the mercy of the winds. A steamer can choose its own route, and navigators aim at sailing as nearly as possible on arcs of a great circle of the earth connecting the ports of departure and arrival, this being the shortest distance between the two ports.

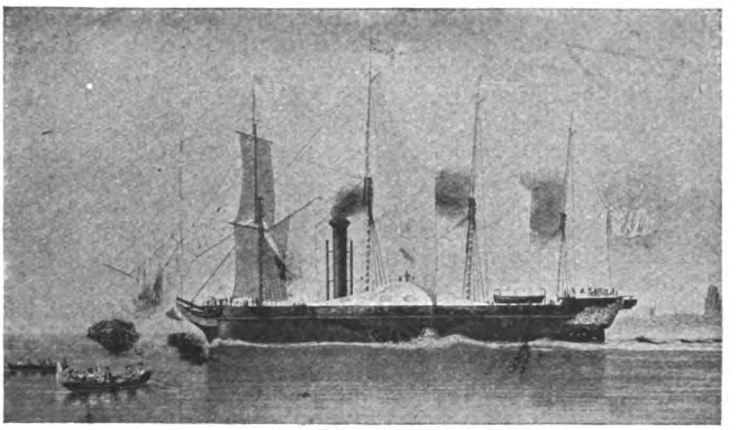
In connection with transport generally it should be pointed out that it is of great importance to avoid numerous handlings of commodities in the course of transit. The general tendency of modern development in transport is to lessen the number of times goods have to be loaded and unloaded, this applying equally to railways, steamship routes, and combinations of both.

Goods are conveyed by sea from any place where they can be obtained, if it is possible to sell them at a profit elsewhere. But the nature of the route depends upon many different conditions. To realise how the nature of the commodities affects the route two main considerations must be borne in mind: firstly, that it is expensive to transfer those commodities from one vehicle to another, and, secondly, that it is cheapest

to carry goods in the largest possible vessels, provided these vessels are filled.

Bulky goods like coal and timber require most handling, and are more likely to be carried direct, as the quantity of the commodity that may be required in a small district may be enough to fill a ship of larger or smaller size as the case may be, and thus much handling is avoided. This is why so many British seaports export coal, for instance, in comparatively small vessels.

On the other hand, tea, coffee, spices, etc., that are shipped from the East to the United Kingdom, come in large ships with other bulky commodities to London, and are then sent away by rail to both British and foreign ports with which London carries on a regular trade.

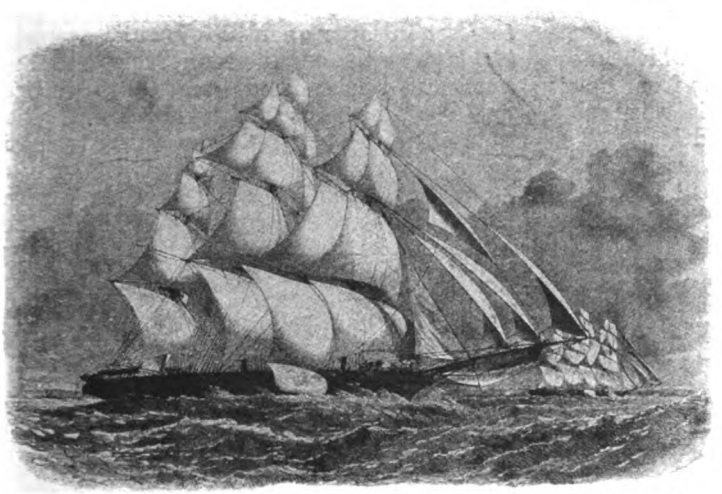


By permission of Messrs. Henry Castle & Sons.

THE "GREAT WESTERN."

Despite fast sailing (*vide* below) sea-borne commerce during the nineteenth century rapidly passed from canvas to steam. In 1838, two vessels, the "Sirius" and the "Great Western," crossed the Atlantic under their own steam. Leaving Bristol on April 8th the "Great Western" (speed 8·2 knots) arrived at New York on April 23rd. On her homeward voyage she carried 68 passengers at 35 guineas apiece, and 20,000 letters.

Then again, the nature of the goods may affect the route, determining whether they should be sent by sailing vessel or steamer, or even by rail over part of the route. This consideration will affect perishable goods such as fruit, butter and eggs, and may also affect such goods as jewellery, silks, etc., that have a high value in proportion to their bulk.



Reproduced from the "Illustrated London News," 1866.

"ARIEL" AND "TAEPING" RACING OFF THE LIZARD.

These two clippers took part in the great "Tea Race" of 1866 organised by the leading London importers who offered a premium to the ship bringing the first of the year's crop from China. "Ariel" and "Taeping" left Foochow on May 30th and, after losing sight of each other for 70 days, found themselves off the Lizard running neck and neck. "Taeping" reached Gravesend half-an-hour ahead of "Ariel," having accomplished the journey in 99 days.

The trade routes of the world for sailing vessels are naturally governed by the prevailing winds, and if the facts noticed when discussing these have been borne in mind, they will throw much light on the actual routes followed.

In any good atlas a map will be given with these routes marked on a map of the world, or of the different oceans, and need hardly be enlarged upon here, and if a comparison of such a map be made with a map showing the prevailing winds, the reasons for a vessel taking the route it does will in nearly all cases be quite clear.

Steamer routes, as we have said, approximate as nearly as possible to arcs of a great circle of the earth. But in some cases it is impossible or incon-

venient to follow these. For instance, the disposition of sea and land would interfere with the following of a great circle route from the Cape of Good Hope to New Zealand, and besides this it would go to the south of the Antarctic Circle. A more northerly course is taken, although it entails travelling a longer distance.

In tracts of the ocean where there is very much traffic, steamers adhere very closely to certain well-known routes in order to avoid risks of collision, and they take slightly different paths on the outward and homeward voyages. On busy routes through more than one ocean the direction of sailing is generally dependent upon the position of coaling stations and important ports at which places goods for adjacent districts can be dropped. Thus vessels taking the Suez Canal route to and from the East may touch at Gibraltar, Algiers, Port Said, and Aden.

At the two former ports goods may be landed for other Mediterranean ports at which the steamers do not call to be transhipped by smaller vessels; and at Aden goods can be dropped by Australian and East Indian steamers for the East African ports.

The Oriental Express

The most important of the routes connecting England with the continent of Europe start from London, and are broken by the sea at Dover, Folkestone, Newhaven, Southampton or Harwich. On the Continent, Paris is the point at which most routes converge for all the ports from Calais to Havre, and through Paris the main routes go for France, Spain, and Italy. The characteristic traffic that passes over the French railways is as follows: silks from the East and Italy, dates from Algiers, watches from Switzerland, French wines from Burgundy, and gloves and woollens from Northern France itself. From England are sent cotton and woollen goods.

Through Paris also runs the Oriental Express route to Constantinople; this goes by Chalons, Strasburg, Stuttgart to Ulm on the Danube. Thence it runs through Munich, Vienna, Budapest to Belgrade, and then on through Nish and Adrianople to Constantinople.

Across Siberia

For that portion of the Continent east of Paris, Berlin is the most important centre. From England, Berlin is reached by the quickest journey via Ostend. Thence the route is through Cologne, Dusseldorf, or else Hanover, to Berlin. From Berlin to Moscow there are two routes, and Moscow is in itself a very important railway focus owing to its central situation and large size. From Moscow the railway runs to Cheliabinsk, which is a junction for Petrograd, and is on the main trans-Siberian route. Over this route come tea and silks from the East, and also furs and butter from Siberia. To the East go agricultural machinery.

In Africa there is as yet no through railway route, as the Cape to Cairo railway is not completed in the central portion.

In North America there are several through routes across the continent, one of them, the Canadian Pacific, entirely through Canada. The only commodity transported from West to East in large quantities is silk, owing to its high price. Californian fruit and also hops and apples from Oregon are carried, and also timber for shipbuilding from British Columbia. The bulk of the goods traffic is from the north-west, east of the Rocky Mountains, such as living animals for the Chicago meat packers, grain, ores and metals. From the East are carried coal and manufactured goods. C. J. S.

Photo: Priestley & Sons, Egremont.

MANCHESTER SHIP CANAL AT EASTHAM.

This canal allows ocean-going steamers to land cotton from U.S.A. directly at Manchester.

Continued from page 432.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.
(M. A. Lewenz, M.A.[Lond.]).

ARITHMETIC.—XVI

119. Ratio.

If we compare two quantities as regards magnitude, we may do so in two ways: either we may state how much greater (or less) the first is than the second, or we may state what multiple (or what part) the first is of the second.

Thus we may say that 8 is greater than 2 by 6, and that 3 is less than 10 by 7. Or we may say that 8 contains 2 four times, and is therefore $\frac{8}{2}$ = 4 times as great as 2, and that 3 is 3 tenth parts of 10, i.e. is $\frac{3}{10}$ of 10.

When we employ this second method of comparison we state the **ratio** of the first quantity to the second. Hence we define **ratio as the relation which one quantity bears to another** as regards magnitude, when we state what multiple or part the first is of the second. It is clear that any fraction of which the first quantity is the numerator and the second quantity is the denominator, will express the ratio of the first to the second. The ratio of 7 oz. to 14 oz. is expressed by the notation 7 oz. : 14 oz. and this equals $\frac{7}{14} = \frac{1}{2}$.

The two quantities compared are called the **terms** of the ratio. Sometimes the first is called the **antecedent** and the second the **consequent.**

What we really compare are numbers, and therefore concrete quantities must be of the same kind and must be expressed in the same denomination.

We cannot compare books with horses, and if we want to find the ratio between 10 minutes and 2 hours we must express both in terms of either minutes or hours. Thus: 10 minutes : 2 hours = 10 minutes : 120 minutes $= \frac{10}{120} = \frac{1}{12}$.
or 10 minutes : 2 hours $= \frac{1}{6}$ hour : 2 hours $= \frac{1}{6} \div 2 = \frac{1}{12}$.

120. Proportion.

When one quantity bears to a second the same ratio that a third bears to a fourth quantity, the four quantities are said to be **proportionals.**

Thus the ratio of 3 cwt. to 5 cwt. is equal to the ratio of £6 to £10.

This is expressed by the following notation,
3 cwt. : 5 cwt. = £6 : £10
or 3 cwt. : 5 cwt. : : £6 : £10
and is generally read thus:
3 cwt. *is to* 5 cwt. *as* £6 *is to* £10.

By what has gone before it is clear that dealing with abstract numbers, the above statement is equivalent to $\frac{3}{5} = \frac{6}{10}$.

Since the terms of a ratio must be of the same kind, it follows that in a proportion the first and second terms must be of the same kind, and the third and fourth terms must be of the same kind.

The first and fourth terms of a proportion are called its **extremes,** and the second and third are called its **means.**

If we take any proportion, say **3 : 7 : : 15 : 35,** this is equivalent to $\frac{3}{7} = \frac{15}{35}$
and therefore $3 \times 35 = 7 \times 15$.

Hence in a proportion **the product of the extremes** equals **the product of the means.**

It is easily seen that if four numbers are in proportion, they will also be in proportion if their order is reversed.

Thus $8 : 9 : : 24 : 27$,

i.e. $\frac{8}{9} = \frac{24}{27}$

$\therefore 1 \div \frac{8}{9} = 1 \div \frac{24}{27}$

$\therefore \frac{9}{8} = \frac{27}{24}$

i.e. $\frac{27}{24} = \frac{9}{8}$ or $27 : 24 : : 9 : 8$.

There are 6 other orders in which the numbers are proportional, and the student should work these out for himself.

121. Three numbers, or quantities of the same kind, are said to be in **continued proportion,** if the ratio of the first to the second equals the ratio of the second to the third.

Thus 2, 6 and 18 are in continued proportion, for 2 : 6 : : 6 : 18.

The second of three such terms is called the **mean proportional** between the first and the third.

122. When any three terms of a proportion are known, the remaining term can be found.

Examples:—

1. What number bears to 12 the same ratio as 2 to 3?

Let us call the required number x.

Then $\frac{x}{12} = \frac{2}{3}$

$\therefore x = \frac{2}{3} \times 12 = \mathbf{8}.$

2. Find the fourth proportional to 4, 7 and 12

$$\frac{4}{7} = \frac{12}{x}$$

$$\therefore \frac{x}{12} = \frac{7}{4} \therefore x = \frac{7}{4} \times 12 = \mathbf{21}.$$

3. Find the mean proportional to 8 and 18

$$\frac{8}{x} = \frac{x}{18} \therefore x^2 = 144 \therefore x = \mathbf{12}.$$

4. To what sum has 3s. 6d. the same ratio as 3 days 5 hours bears to 7 day 8 hrs. ?

$$\frac{3s.\ 6d.}{x} = \frac{3\frac{5}{24}\text{ days}}{7\frac{8}{24}\text{ days}} = \frac{\frac{77}{24}\text{ days}}{\frac{176}{24}\text{ days}} = \frac{7\text{ days}}{16\text{ days}}$$

$$\therefore x = \frac{16}{7} \text{ of 3s. 6d.} = \mathbf{8s.}$$

5. If 2 cwt. 12 lb. cost £2 14s. 1d., what will 5 cwt. 20 lb. cost at the same rate ?

$$\frac{x}{£2\frac{169}{240}} = \frac{5\frac{20}{112}\text{ cwt.}}{2\frac{12}{112}\text{ cwt.}} = \frac{580\text{ lb.}}{236\text{ lb.}}$$

$$\therefore x = \tfrac{580}{236} \text{ of } £2\tfrac{169}{240} = \mathbf{£6\ 12s.\ 11d.}$$

The student should note that, as a rule, the simplest way to find the missing term of a proportion is to make use of the **Unitary Method.**

A proportion may often be simplified by dividing the first and second terms, the first and third terms, the second and fourth terms or the third and fourth terms by their highest common factor.

Thus 6 : 15 :: 14 : 35 is the same as $\frac{6}{15} = \frac{14}{35}$, which is the same as $\frac{2}{5} = \frac{14}{35}$, which is the same as 2 : 5 :: 14 : 35.

Again, 6 : 15 :: 14 : 35 is the same as $\frac{6}{15} = \frac{14}{35}$, which is the same as $\frac{3}{15} = \frac{7}{35}$, which is the same as 3 : 15 :: 7 : 35

Again 6 : 15 :: 14 : 35 is the same as $\frac{6}{15} = \frac{14}{35}$ which is the same as $\frac{6}{3} = \frac{14}{7}$, which is the same as 6 : 3 :: 14 : 7.

And lastly 6 : 15 :: 14 : 35 is the same as $\frac{6}{15} = \frac{14}{35}$, which is the same as $\frac{6}{15} = \frac{2}{5}$, which is the same as 6 : 15 :: 2 : 5.

The student should note, however, that we cannot divide the first and fourth terms, or the second and third terms, by a common factor.

Thus 6 : 15 :: 18 : 45 is the same as $\frac{6}{15} = \frac{18}{45}$, but $\frac{2}{15}$ does not $= \frac{18}{15}$, nor does $\frac{6}{5} = \frac{6}{45}$.

123. We will now give a few examples of a more complicated nature.

Examples :—

1. If 10 men mow 25 acres of grass in 3 days, how many men would be required to mow 35 acres in 6 days ?

First consider the effect on the number of men of increasing the number of days, leaving the number of acres unchanged.

In 3 days 10 men mow 25 acres.

$\therefore$ in 1 day 10×3 men mow 25 acres.

$\therefore$ in 6 days $\frac{3 \times 10}{6}$ men mow 25 acres.

Now find the change due to the increase in acres.

25 acres are mown in 6 days by $\frac{3 \times 10}{6}$ men.

$\therefore$ 1 acre is mown in 6 days by $\frac{3 \times 10}{6 \times 25}$ men.

$\therefore$ 35 acres are mown in 6 days by $\frac{3 \times 10 \times 35}{6 \times 25} =$ **7 men.**

In the first part, the two corresponding quantities are 3 days and 6 days, and in the second part 25 acres and 35 acres. Now *fewer* men are needed to mow the same quantity of acres if the number of days is increased, hence we multiply the original number of men by the proper fraction $\frac{3}{6}$. On the other hand, if the acres are increased in number, a *greater* number of men are needed, and hence we multiply by the improper fraction $\frac{35}{25}$.

In other words, if one quantity varies *inversely* as another, we multiply by the inverse ratio, and if a quantity varies directly as another, we multiply by the direct ratio.

After a little practice the student should be able to write down the result at once without the intervening reasoning.

Thus :

2. If 1,000 men in a besieged town with provisions for 5 weeks, allowing each man 16 oz. a day, be reinforced with 500 men more and have their daily rations reduced to $6\frac{2}{3}$ oz., how long will the provisions last them ?

Since the *daily* rations are given, we must express the weeks in days:

5 weeks = 35 days.

Now the number of days the provisions will last decreases as the number of men increases, i.e. the number of days varies inversely as the number of men, and we therefore multiply by the inverse ratio $\frac{1000}{1500}$.

Again, the number of days the provisions will last increases as the daily rations decrease, i.e. varies inversely as the number of oz. in the daily ration, we therefore also multiply by the inverse ratio $\frac{16}{6\frac{2}{3}}$.

Hence the required number of days

$= 35 \times \frac{1000}{1500} \times \frac{16 \times 3}{20} = 56$ days $=$ **8 weeks.**

3. If 125 men can make an embankment 100 yards long 20 feet wide and 4 feet high in 4 days, working 12 hours a day, how many men are needed to make an embankment 1000 yards long, 16 feet wide and 6 feet high in 3 days, working 10 hours a day ?

Volume of 1st embankment $= 100 \times 3 \times 20 \times 4$ cub. ft.

Volume of 2nd embankment $= 1000 \times 3 \times 16 \times 6$ cub. ft.

Number of hours worked by 1st lot of men = 4×12.

Number of hours worked by 2nd lot of men = 3×10.

$\therefore$ number of men required

$$= 125 \times \frac{1000 \times 3 \times 16 \times 6}{100 \times 3 \times 20 \times 4} \times \frac{4 \times 12}{3 \times 10} = \textbf{2,400 men.}$$

The student should work out examples 2 and 3 by unitary method.

Exercise 41

Express in their simplest forms the following ratios :

1. 39 : 52. 2. 145 : 203. 3. £75 10s. : £10.
4. 3 cwt. 14 lb. : 4 cwt. 1 qr. 14 lb. 5. 5 hrs. 24 min. : 2 hrs. 42 min.
6. What sum of money bears to 2s. the ratio 1 in. : 1 ft. ?
7. What sum of money bears to 12s. the ratio 3 ft. : 6 ft. ?
8. What sum of money bears to 11s. the ratio 1 yd. : 1 pole ?
9. To what sum does 1 guinea bear the same ratio as a week to a day ?
10. To what does a mile bear the same ratio as 1 lb. : 1 oz. ?
11. Express $\frac{1}{5} : \frac{1}{7}$ as the ratio of 2 whole numbers.
12. Express $\frac{1}{8} : \frac{1}{5}$ as the ratio of 2 whole numbers, one of which is 100.
13. If £100 becomes £130, in what ratio is it increased ?
14. If £100 becomes £75, in what ratio is it decreased ?
15. If £50 is increased in the ratio 7 : 5 what does it become ?
16. If £120 is decreased in the ratio 5 : 6 what does it become ?
17. Which is the greater ratio 7 : 8 or 8 : 9 ?
18. Which is the greater ratio 32 : 19 or 7 : 4 ?

Exercise 42

1. Two watches, one of which gains as much as the other loses, namely : 2 m. 5 sec. daily, are set right at 9 A.M. on Monday, when will there be a difference of one hour in the times they indicate ?
2. If 1,000 men have provisions for 90 days and after 5 days 150 men go away, find how long the remaining provisions will serve the number of men left.
3. A alone can reap a field in 5 days, B alone can reap the same field in 6 days, each working 11 hours a day. Find in what time A and B together can reap it, working 10 hours a day.
4. If 15 men can be fed for a week at a certain cost when wheat is 4s. per bushel, what must be the cost per bushel when 10 men can be fed for 8 days at the same cost ?
5. If 24 oxen require 6 acres of turnips to feed them for 8 weeks, how many acres would supply 60 sheep for 12 weeks, 3 oxen eating as much as 10 sheep ?

Key to Exercise 39

1. £4 11s. 9½d. (to the nearest farthing).
2. £1 10s. 9½d. 3. 9 ft. 4. 629 cub. ft. 5. 182250.

Key to Exercise 40

1. 2 hours 40 min. 2. £613 2s. 8d. 3. 24 days.
4. 4s. 9d. ; £9 9s. 5d.

M. A. L.

ALGEBRA.—XVI

99. Equations with more than Two Variables.

There are no general rules for the solution of these, but a few typical examples are given.

Examples :—

(1) Solve $x(x+y+z) = a^2$ ..... (i)
$y(x+y+z) = b^2$ ..... (ii)
$z(x+y+z) = c^2$ ..... (iii)

$$\frac{x}{a^2} = \frac{y}{b^2} = \frac{z}{c^2} = \frac{1}{x+y+z}$$

Add (i), (ii), and (iii), then $(x+y+z)^2 = a^2 + b^2 + c^2$

$$\therefore x+y+z = \pm\sqrt{a^2+b^2+c^2}$$

Hence we have $\frac{x}{a^2} = \frac{y}{b^2} = \frac{z}{c^2} = \frac{1}{\pm\sqrt{a^2+b^2+c^2}}$

(2) Solve $x^2 + 2yz = 12$ ..... (i)
$y^2 + 2zx = 12$ ..... (ii)
$z^2 + 2xy = 12$ ..... (iii)

from (i) and (ii) by subtraction

$(x-y)(x+y-2z) = 0$

$\therefore$ either $x = y$ or $x + y - 2z = 0$

(i) If $x = y$ then as the equations are homogeneous and symmetrical, $x = y = z$.

Hence from (i) $3x^2 = 12$ $\therefore x = \pm 2$

i.e. $x = y = z = \pm 2$

(ii) If $x + y - 2z = 0$

Add (i), (ii), and (iii), then $(x+y+z)^2 = 36$

$\therefore x + y + z = \pm 6$

$\therefore 3z = \pm 6$ $\therefore z = \pm 2$

i.e. $x = y = z = \pm 2$.

(3) Solve $(y+b)(z+c) = a^2$ ..... (i)
$(z+c)(x+a) = b^2$ ..... (ii)
$(x+a)(y+b) = c^2$ ..... (iii)

Multiply (ii) and (iii) and divide by (i)

Then $(x+a)^2 = \frac{b^2c^2}{a^2}$ $\therefore x + a = \pm\frac{bc}{a}$

$\therefore x = -a \pm \frac{bc}{a}$

Similarly $y = -b \pm \frac{ca}{b}$ and $z = -c \pm \frac{ab}{c}$

(4) Solve $x + y + z = 13$ ..... (i)
$x^2 + y^2 + z^2 = 65$ ..... (ii)
$xy = 10$ ..... (iii)

From (ii) and (iii) $(x+y)^2 + z^2 = 85$

Put u for $(x+y)$ then

$$u^2 + z^2 = 85$$

from (1) $u + z = 13$

The solutions of this are clearly $u = 6$, $z = 7$, and $u = 7$, $z = 6$.

hence $x + y = 7$ or $x + y = 6$

if $x + y = 7$ and $xy = 10$ $\left.\begin{matrix}\\\\\end{matrix}\right\}$ $x = 5$, $y = 2$ and $z = 6$ or $x = 2$, $y = 5$, $z = 6$

if $x + y = 6$ and $xy = 10$ $\left.\begin{matrix}\\\\\end{matrix}\right\}$ $x = 3 \pm \sqrt{-1}$, $y = 3 \mp \sqrt{-1}$, $z = 7$

100. Problems leading to Simultaneous Equations.

(1) A and B start simultaneously from 2 towns, and met after 5 hours. If A had travelled 1 mile per hour faster, and B had started 1 hour sooner, or if B had travelled 1 mile per hour slower and A had started 1 hour later, they would in either

case have met at the same spot at which they actually met. What was the distance between the towns ?

Let x = number of miles per hour A travels
,, y = ,, ,, ,, B ,,
Distance between the towns = $5(x+y)$ miles.

If A travels 1 mile per hour faster he will do $5x$ miles in $\frac{5x}{x+1}$ hours.

Hence B will travel for $\frac{5x}{x+1}+1 = \frac{6x+1}{x+1}$ hrs.

In $\frac{6x+1}{x+1}$ hours B does $\left(\frac{6x+1}{x+1}\right)y$ miles, and this must be the same distance he travelled before.

$$\therefore \left(\frac{6x+1}{x+1}\right)y = 5y \quad \ldots\ldots\ldots\ldots\ldots \text{(i)}$$

$$\therefore y = 0 \text{ or } 6x+1 = 5x+5$$

i.e. $x = 4$

(the solution $y = 0$ is rejected as impossible).

If B travels 1 mile per hour slower he will do $5y$ miles in $\frac{5y}{y-1}$ hours.

$\therefore$ A will travel for $\frac{5y}{y-1} - 1 = \frac{4y+1}{y-1}$ hours.

In $\frac{4y+1}{y-1}$ hours A travels $\left(\frac{4y+1}{y-1}\right)x$ miles, and this must be the same distance as before

$$\therefore \left(\frac{4y+1}{y-1}\right)x = 5x \quad \ldots\ldots\ldots\ldots\ldots \text{(ii)}$$

$\therefore x = 0$ or $4y+1 = 5y-5$

i.e. $y = 6$

(the solution $x = 0$ is rejected as impossible)

$\therefore$ distance between the towns $= 5(4+6) = 50$ miles.

(2) A number consists of 3 digits whose sum is 10. The middle digit is equal to the sum of the other two ; and the number will be increased by 99 if its digits be reversed. Find the number.

Let x be digit in units place,
,, y ,, ,, hundreds ,,
then $(x+y)$ is digit in tens place.

$$x+y+(x+y) = 10$$

$$\therefore 2(x+y) = 10$$

$$\therefore x+y = 5 \quad \ldots\ldots\ldots\ldots\ldots \text{(i)}$$

$$100y + 10(x+y) + x = 100x + 10(x+y) + y - 99$$

$$\therefore 99x - 99y = 99$$

$$\therefore x - y = 1 \quad \ldots\ldots\ldots\ldots\ldots \text{(ii)}$$

from (i) and (ii) $2x = 6 \therefore x = 3$

$\therefore y = 2$

$\therefore$ the number is 253.

(3) A train 60 yards long passed another train 72 yards long, which was travelling in the same direction on a parallel line of rails in 12 seconds. Had the slower train been travelling half as fast again, it would have been passed in 24 seconds. Find the rates at which the trains were travelling.

Let x be number of miles per hour faster train travels
,, y ,, ,, ,, slower ,, ,,

Fast train gains $(x-y)$ miles on slow train in 1 hr.

$\therefore$ gains $\frac{(x-y)\,1760}{60\times 60} \times 12$ yards in 12 seconds

$$\therefore \frac{88}{15}(x-y) = 72+60 = 132 \quad \ldots\ldots\ldots \text{(i)}$$

In the second case we have

$$\frac{176}{15}\left(x-\frac{3y}{2}\right) = 72+60 = 132 \ldots\ldots \text{(ii)}$$

From (i) and (ii)

$$\frac{88}{15}(x-y) = \frac{176}{15}\left(x-\frac{3y}{2}\right)$$

$$\therefore x-y = 2\left(x-\frac{3y}{2}\right)$$

$$= 2x-3y$$

$$\therefore x = 2y$$

putting this value of x in (i) we have

$$\frac{88}{15}y = 132$$

$$\therefore y = \frac{45}{2} = 22\tfrac{1}{2} \text{ miles per hour.}$$

$\therefore x = 45$ miles per hour.

(4) Twenty men and women spent £2 8s. The women spent as much altogether as the men, but each man spent 1s. more than each woman. How many men were in the party ?

Let x = number of men
,, y = ,, women

$$x+y = 20 \quad \ldots\ldots\ldots\ldots\ldots \text{(i)}$$

each woman spent $\frac{24s.}{y}$

each man spent $\frac{24s.}{x}$

$$\frac{24}{x} = \frac{24}{y} + 1 \quad \ldots\ldots\ldots\ldots\ldots \text{(ii)}$$

$$\therefore 24y = 24x + xy \quad \ldots\ldots\ldots\ldots\ldots \text{(iii)}$$

from (i) $y = 20 - x$

Substitute this value in (iii)

$$(20-x)\,24 = 24x + x(20-x)$$

$$\therefore x^2 - 68x + 480 = 0$$

$$(x-8)(x-60) = 0$$

$$\therefore x = 8 \text{ or } x = 60$$

$x = 60$ is inadmissible $\therefore$ the number of men $= 8$.

101. Elimination.

When more equations are given than are required to determine the variables, it is often important to find the relation connecting the constants. This is done by eliminating the variables, as the following examples will show.

Examples :—

(1) Eliminate $x+y$ from

$$ax+by+c = 0 \quad \ldots\ldots\ldots\ldots\ldots \text{(i)}$$

$$a'x+b'y+c' = 0 \quad \ldots\ldots\ldots\ldots\ldots \text{(ii)}$$

$$a''x+b''y+c'' = 0 \quad \ldots\ldots\ldots\ldots\ldots \text{(iii)}$$

From (i) and (ii) we have (§ 95)

$$\frac{x}{bc'-b'c} = \frac{y}{ca'-c'a} = \frac{1}{ab'-a'b}$$

Substitute these values of x and y in (iii) and we have

$$a''\frac{bc'-b'c}{ab'-a'b} + b''\frac{ca'-c'a}{ab'-a'b} + c'' = 0$$

$$\therefore a''(bc'-b'c) + b''(ca'-c'a) + c''(ab'-a'b) = 0$$

(2) Eliminate x from the equations

$$ax^2+bx+c = 0 \quad \ldots\ldots\ldots\ldots\ldots \text{(i)}$$

$$a'x^2+b'x+c' = 0 \quad \ldots\ldots\ldots\ldots\ldots \text{(ii)}$$

As before $\frac{x^2}{bc'-b'c} = \frac{x}{ca'-c'a} = \frac{1}{ab'-a'b}$

$$x^2 = \frac{bc'-b'c}{ab'-a'b} \quad \ldots\ldots\ldots\ldots\ldots \text{(iii)}$$

and $x = \dfrac{ca' - c'a}{ab' - a'b}$

$\therefore\ x^2 = \dfrac{(ca' - c'a)^2}{(ab' - a'b)^2}$ ..... (iv)

From (iii) and (iv) $(bc' - b'c)(ab' - a'b) = (ca' - c'a)^2$

(3) Eliminate x, y and z from the equations

$x^2(y + z) = a^2$ ..... (i)
$y^2(z + x) = b^2$ ..... (ii)
$z^2(x + y) = c^2$ ..... (iii)
$xyz = abc$ ..... (iv)

From (i), (ii) and (iii) by multiplication, we have

$x^2y^2z^2(y + z)(z + x)(x + y) = a^2b^2c^2$ ..... (v)

$\therefore$ from (iv) and (v) $(y + z)(z + x)(x + y) = 1$

i.e. $x^2(y + z) + y^2(z + x) + z^2(x + y) + 2xyz = 1$

$\therefore\ a^2 + b^2 + c^2 + 2abc = 1.$

102. Equations in which there is some restriction on the values of the letters.

(1) Show that if $\dfrac{x}{a} + \dfrac{y}{b} + \dfrac{z}{c} = 1$

and $\dfrac{a}{x} + \dfrac{b}{y} + \dfrac{c}{z} = 0$

then $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} + \dfrac{z^2}{c^2} = 1$

$\dfrac{a}{x} + \dfrac{b}{y} + \dfrac{c}{z} = 0$

$\therefore\ ayz + bzx + cxy = 0$ ..... (i)

$\dfrac{x}{a} + \dfrac{y}{b} + \dfrac{z}{c} = 1$

$\therefore \left(\dfrac{x}{a} + \dfrac{y}{b} + \dfrac{z}{c}\right)^2 = 1$

$\therefore \dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} + \dfrac{z^2}{c^2} + \dfrac{2}{abc}(ayz + bzx + cxy) = 1$

but $ayz + bzx + cxy = 0$

$\therefore \dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} + \dfrac{z^2}{c^2} = 1$

(2) If $x = cy + bz$ ..... (i)
$y = az + cx$ ..... (ii)
$z = bx + ay$ ..... (iii)

show that $\dfrac{x}{1 - a^2} = \dfrac{y}{1 - b^2} = \dfrac{z}{1 - c^2}$

substituting the value of z given by (iii) in (i)

$x = cy + b(bx + ay)$

$\therefore\ x(1 - b^2) = y(ab + c)$ ..... (iv)

and substituting the same value of z in (ii)

$y = a(bx + ay) + cx$

$\therefore\ x(ab + c) = y(1 - a^2)$ ..... (v)

Multiplying (iv) and (v)

$x^2(1 - b^2) = y^2(1 - a^2)$

$\therefore\ \dfrac{x^2}{1 - a^2} = \dfrac{y^2}{1 - b^2}$

Similarly $\dfrac{x^2}{1 - a^2} = \dfrac{z^2}{1 - c^2}$

$\therefore\ \dfrac{x^2}{1 - a^2} = \dfrac{y^2}{1 - b^2} = \dfrac{z^2}{1 - c^2}.$

Exercise 22

(1) In digging a trench 433 yards long, A works at it for 19 hours, then B takes his place and finishes the work in 16 hours. On a similar trench 541 yards long, B works for 30 hours, then A takes his place and finishes the work in 11 hours. How long would it take them working together, to dig a trench 200 yards long?

(2) A man buys 99 boxes of fruit at a certain price: they would have cost him 1s. less if he had obtained for each shilling four more boxes than he actually did receive. What price did he pay?

(3) The time of swing of a pendulum is equal to $K\sqrt{l}$ seconds, where l is the length of the pendulum in inches and K is a constant. The length of a pendulum beating seconds is 39.14 inches; hence find the time of a swing of a pendulum 60 inches long.

(4) Two men A and B can walk at 3 and 4 miles per hour and cycle 12 and 15 miles per hour respectively. Having only one bicycle between them, they have to travel 120 miles, starting and arriving simultaneously. They agree that A shall ride first, then dismount, leave the bicycle and finish the journey on foot; when B reaches the bicycle, he will rest for three hours and then complete the journey on the machine. Find the time taken on the journey and also find how soon A must dismount, giving each result to the nearest minute.

[The above questions are from the London Matric. Exam.]

Exercise 23

(1) Eliminate x from $mx^2 - nx + p = o$ and $nx + m = o$

(2) Eliminate x and y from $x - y = a$, $x^2 - y^2 = b$, $x^3 - y^3 = c$.

(3) Eliminate x, y and z from $\dfrac{y - z}{y + z} = a$, $\dfrac{z - x}{z + x} = b$, $\dfrac{x - y}{x + y} = c$

(4) If $x + \dfrac{1}{y} = y + \dfrac{1}{z} = z + \dfrac{1}{x}$ show that $x^2y^2z^2 = 1$, or $x = y = z$.

(5) Show that, if $x^2 = y^2 + z^2 + 2ayz$, $y^2 = z^2 + x^2 + 2bzx$ and $z^2 = x^2 + y^2 + 2cxy$; then

$$\frac{x^2}{1 - a^2} = \frac{y^2}{1 - b^2} = \frac{z^2}{1 - c^2}$$

Key to Exercise 20

(1) $x = -3$, $y = 3$, $z = 1$

(2) $x = b + c$, $y = c + a$, $z = a + b$

(3) $x = 1$, $y = 0$, $z = 0$

(4) $x = \dfrac{p(p - b)(p - c)}{a(a - b)(a - c)}$, $y = \dfrac{p(p - c)(p - a)}{b(b - c)(b - a)}$

$z = \dfrac{p(p - a)(p - b)}{c(c - a)(c - b)}$

Key to Exercise 21

(1) $x = 17$, $y = 34$ or $x = 34$, $y = 17$

(2) $x = 43$, $y = 25$ or $x = -25$, $y = -43$

(3) $x = 10$, $y = 2$ or $x = 10$, $y = -2$

(4) $x = \pm\dfrac{a}{3}$, $y = \pm b$ or $x = \pm a$, $y = \pm\dfrac{b}{3}$

(5) $x = o$, $y = o$ or $x = \dfrac{1}{2}$, $y = \dfrac{1}{6}$ or $x = \dfrac{1}{6}$, $y = \dfrac{1}{2}$

(6) $x = 2$, $y = 1$ or $x = 1$, $y = 2$

(7) $x = 5$, $y = 4$ or $x = 4$, $y = 5$

(8) $x = \pm 9$, $y = \pm 3$ or $x = \pm 3$, $y = \pm 9$

(9) $x = 12$, $y = 2$ or $x = 8$, $y = -2$

(10) $x = 4$, $y = \dfrac{3}{2}$ or $x = 3$, $y = 2$ or $x = 6$, $y = 1$ or $x = 2$, $y = 3$

(11) $x = 7$, $y = -3$ or $x = \dfrac{31}{7}$, $y = -\dfrac{9}{7}$

(12) $x = 0{\cdot}89$, $y = 0{\cdot}77$ or $x = -3{\cdot}4$, $y = -7{\cdot}8$

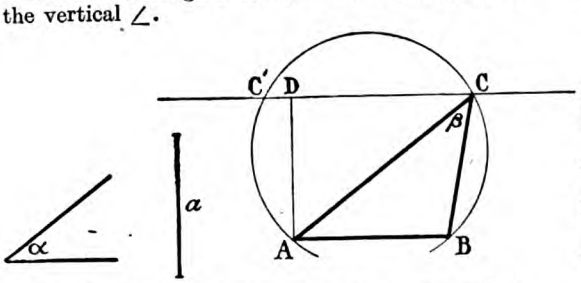
M. A. L.

GEOMETRY.—XV

Additional Problem A

Describe a triangle having given the base, the altitude and the vertical angle.

Let A P be the given base, a the altitude, and α the vertical $\angle$.



On A B describe a segment of a ○ containing an $\angle = \alpha$ (Prop. 89).

At A draw A D $\perp$ to A B on the same side of A B as the segment. Make A D $= a$ (Prop. 21).

Through D draw a str. line $\parallel$ to A B cutting the segment in C and C′ (Prop. 29).

Join A C and B C. A B C is the required $\triangle$.

Proof.—Its base is A B; the altitude = A D $= a$,

β is $\angle$ in the segment A C B $\therefore \beta = \alpha$,

The $\triangle$ A C′ B would also fulfil the given conditions.

Additional Problem B

Describe a triangle having given the altitude, the vertical angle, and the perimeter.

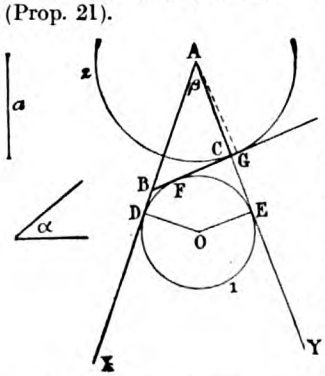
Let A X be the given perimeter, a the given altitude and α the vertical $\angle$.

At pt. A in str. line X A make $\angle \beta = \angle \alpha$ (Prop. 18).

Bisect A X at D (Prop. 20).

From A Y cut off A E = A D.

Draw $\perp$s to A X, A Y at D and E, meeting in O (Prop. 21).



With centre O and radius O D describe ⊙ 1.

With centre A and radius $= a$ describe ⊙ 2.

Draw a transverse common tangent to ⊙s 1 and 2, touching 1 at F and 2 at G, and cutting A D at B and A E at C.

A B C is the required $\triangle$.

Proof.—By joining A O it is easily shown that O D = O E $\therefore$ ⊙ 1 passes through E.

Further A D, A E are tangents to 1 at D and E.

($\because$ A D, A E are $\perp$ to radii O D, O E) (Prop. 74).

Now B F = B D and C F = C E (tangents to ⊙ from a pt.) (Prop. 80, cor. 1).

$\therefore$ A B + B D + A C + C E = A B + B F + A C + C F

$\therefore$ A D + A E = A B + A C + B C

but A D = A E = $\frac{1}{2}$ of A X, the given perimeter

$\therefore$ A B + A C + B C = A X

Also $\angle \beta$ has been made $= \alpha$

Lastly $\because$ B C touches (2) at G $\therefore$ A G is $\perp$ to B G (Prop. 74).

i.e. A G = altitude of $\triangle$ A B C

but A G $= a$

$\therefore$ altitude of $\triangle = a$.

* * *

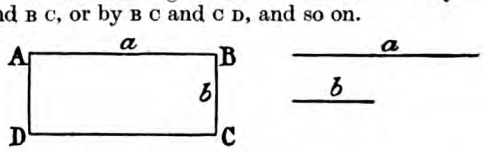
We have shown in an earlier lesson that the area of a rectangle is found by multiplying its length by its breadth.

Similarly the area of a square is found by multiplying the length of the side by itself, or (to put it algebraically) by "squaring" the length of the side.

The following Propositions illustrate and verify geometrically several algebraic formulæ.

A rectangle is said to be CONTAINED by any two adjacent sides.

Thus the rectangle A B C D is contained by A B and B C, or by B C and C D, and so on.



It is often written rect. A B, B C.

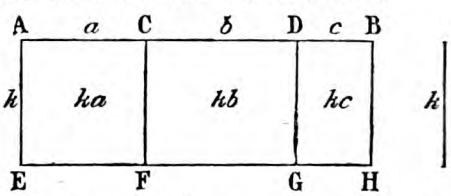
Also if a and b are two straight lines respectively = A B + B C, then rect. A B, B C = rect. $a\,b$.

Proposition 90. Theorem

If there be two straight lines, one of which is divided into a number of parts, the rectangle contained by the two straight lines is equal in area to the sum of the rectangles contained by the undivided line and the several parts of the divided line.

Let A B and K be the two str. lines, and let A B be divided into any number of parts A C, C D, D B.

It is required to prove that rect. k, A B = rect. k, A C + rect. k, C D + rect. k, D B.



Proof.—From A draw A E $\perp$ to A B and $= k$ (Prop. 21).

Through E draw a str. line $\parallel$ to A B, and through C, D and B draw C F, D G, B H, $\parallel$ to A E and cutting the str. line through E $\parallel$ to A B at F, G and H (Prop. 29).

Then the figures A F, C G, D H are all rectangles.

A E $= k$ $\therefore$ Fig. A F = rect. k, A C.

Similarly Fig. C G = rect. k, C D

and Fig. D H = rect. k, D B

for the opp. sides of a rect. are equal and

$\therefore$ A E = C F = D G = B H (Prop. 31).

But Fig. A H is made up of Figs. A F, C G, D H

$\therefore$ rect. k, A B = rect. k, A C + rect. k, C D + rect. k, D B.

Now if we designate the lines by single letters

putting A C = a, C D = b, D B = c

then rect. k, A B = rect. k $(a + b + c)$

and rect. k, A C = rect. $k\,a$; rect. k, C D = rect. $k\,b$ and rect. k, D B = rect. $k\,c$.

Hence we have proved geometrically the algebraic formula

k (a + b + c) = ka + kb + kc.

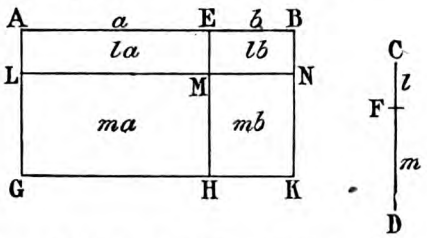
Proposition 91. Theorem

If two straight lines be divided into two parts the rectangle contained by the two lines equals the sum of the four rectangles contained by the parts.

Let A B, C D be two str. lines divided into two parts at E and F respectively.

It is required to prove that the rect. A B, C D = rect. A E, C F + rect. E B, C F + rect. A B, F D + rect. E B, F D.

Proof.—From A draw A G ⊥ to A B making A G = C D (Prop. 21).



Through G draw a str. line || to A B and through E and B draw str. lines || to A G cutting the || to A B through G at H and K (Prop. 29).

From A G cut off A L = C F and through L draw a str. line || to A B cutting E H and B K at M and N respectively.

The Figs. A M, E N, L H, M K are all rectangles.

A L = C F ∴ Fig. A M = rect. A E, C F.

A L = E M = B N (opp. sides of rectangles are equal) (Prop. 31).

∴ Fig. E N = rect. E B, C F.

Now A G = C D and A L = C F ∴ L G = F D

again L G = M H = N K

Also L M = A E and M N = E B (Prop. 31).

∴ Fig. L H = rect. A E, F D and Fig. M K = rect. E B, F D.

But Fig. A K is made up of Figs. A M, E N, L H, M K

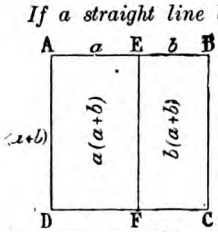
∴ rect. A B, C D = rect. A E, C F + rect. E B, C F + rect. A E, F D + rect. E B, F D.

If now we put A E = a, E B = b, C F = l and F D = m we find we have proved the algebraic formula

(a + b) (l + m) = la + lb + ma + mb.

Proposition 92. Theorem

If a straight line be divided into any two parts the square on the whole line is equal to the sum of the rectangles contained by the whole line and each of the parts.



This is only a particular case of Prop. 90, in which the first line is divided into 2 parts, and the second line = the first line.

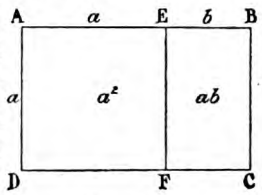
It is equivalent to the algebraic formula

$(a + b)^2 = a(a + b) + b(a + b)$.

Proposition 93. Theorem

If a straight line be divided into any two parts, the rectangle contained by the whole line and one of the parts is equal to the square on that part together with the rectangle contained by the parts.

This again is a particular case of Prop. 90 in which the first line is divided into two parts and the second line = one of the parts in the first line, so that one of the rectangles becomes a square.

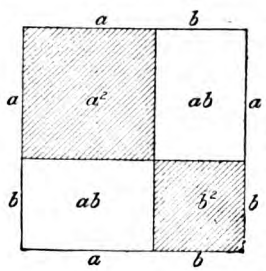


It is equivalent to the algebraic formula

$(a + b)\,a = a^2 + ab$

Proposition 94. Theorem

If a straight line be divided into two parts the square on the whole line equals the sum of the squares on the parts together with twice the rectangle contained by the two parts.



This is a particular case of Prop. 91 in which we proved that $(a + b)$ $(l + m) = la + lb + ma + mb$. Since we may take any values whatever for l and m, we put $l = a$, $m = b$.

Thus we get **(a + b) (a + b) = aa + ab + ba + bb = a^2 + 2ab + b^2.**

Exercise 18

(1) Construct a triangle having given the vertical angle, one of the sides containing it, and the altitude.

(2) Describe a circle to touch a given circle and to touch a given straight line at a given point.

(Take A O B a diameter of given ○, ⊥ to given str. line. Join A or B to given pt. C, meeting ○ at D. The centre of required ○ lies on O D produced and also on the ⊥ to the given line at C.)

(3) All circles whose centres lie on a given straight line and which pass through a fixed point, also pass through another fixed point.

(4) If the incircle of triangle A B C touch B C at D, C A at E and A B at F, show that A F = A E = $s - a$, B F = B D = $s - b$, C D = C E = $s - c$ where a = B C, b = C A, c = A B and $2s = a + b + c$.

(5) If an escribed circle of the triangle A B C touch B C externally at D, show that, with the above notation B D = $s' - c$ and C D = $s - b$.

(6) Describe a circle of which an arc is given.

(7) Bisect a given arc.

(8) A B is any chord of a circle with centre O; it is produced to C so that B C = A O; C O is joined cutting the circle at D, and is produced to cut it again at E; show that angle A O E equals three times angle B O D.

(9) A B C D is a quadrilateral inscribed in a circle, and the bisector of angle B A D meets the circumscribed circle in E. Prove that E C bisects the angle between D C and B C produced.

(10) Prove that the middle points of chords equidistant from the centre of a circle lie on another circle.

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Continued from page 435.

ART AND MUSIC:

Contributors:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).

DRAWING.—X

An extremely valuable exercise for the purposes of shading is to be found in the various forms of vases. It is possible that you may not be able to procure a perfectly simple model very easily, for the reason that the tendency for many years past has been to reject the simple, old and fine shapes in preference for the complicated and over-ornamented.

However, your purpose will be served well enough if you make large copies of the figures given here and so get into the habit of drawing the simpler shapes. Once having accustomed yourself to these forms, you can safely draw from the nearest model to your hand. Drawing from the actual object itself, it should be borne in mind, is the better exercise of the two.

Shading Exercises

Take Fig. 58. This is a common shape even to-day. It is divided into three parts for the purposes of drawing—the neck, the body, and the foot. Now suppose that the light slants down from above on the right and keeping that in mind if you are not drawing from the actual object but the copy here, begin to draw the outline. First of all outline the cast shadow on the ground and on the foot. This is most satisfactorily done with charcoal very lightly used. Use this too to mark in the outline of the shade above—that is, on the neck and body. Now make careful note of the lightest tone in the whole object and shade everywhere in that tone.

Remember that in a cylindrical figure the darkest portion of shade is not at the very edge. So you will make the shades here accordingly. Notice also that the high light on a sphere, on the other hand, comes at a particular point: moreover, the shade-edge goes at right angles to the direction of the shaft of light. Mark these lights and shades; giving a faint outline of the various shades.

Notice that a very dark shadow is cast over the body by the neck; a clear edge is given to it also, for the same reason. The body casts a shadow on the foot with the same result, viz., a clean cut edge and a dark shadow. You should lastly graduate the tones and half-tones in the direction of the high light and until they tail off there.

The lip of the vase as seen in the picture may well be practised separately, and for this purpose you should make a study on a larger scale. Notice that the brightest part is exactly opposite the light. Graduate thence to the deepest shadow cast by the rim. This process applies also to the inside of cups and bowls, and, to take a perfectly different instance, to a modified extent it applies also to the inside of a hat.

Group Models

Good practice may also be derived from the slightly more troublesome shape of vase seen in Fig. 57. The body in this case is egg-shaped. Remember that in drawing an egg or any like form the high light will follow the line of the object's actual curve and so will be modified by the rest of the object as in Fig. 57.

Your attention should now be called for a while to *groups*.

The grouping of several objects is a difficult matter, quite apart from shading. It is all very well to draw—say—a chair and a table and a number of books and a vase of flowers and a window, severally. But place the table in front of the window, put a vase of flowers on it and a pile of books, and draw up the chair at one side and draw the whole combination of objects and you will find the difference.

For the most part shadows are the same, or rather the big masses of tone are much the same on each separate object. But naturally there will be cast shadows where there were none before, thrown by one object upon one or more of the others. Take Fig. 59, and consider it carefully before you begin to draw it. You will notice that the lower side of the cylinder is a good deal lighter than might be expected. This is owing to the fact that reflected light comes to it from the body of the vase. In the same way the neck of the latter casts a shadow into the square pyramid to the right. The pyramid is so placed that two of its sides are touched with shadow, which thus forms an irregular shape. The shadow thrown by the body of the rose on the pyramid merges into that thrown by the cylinder.

When you come to draw this group of objects take care to arrange them (if you are working from

the actual models) exactly as they are in the diagram; also arrange that the light falls from the left-hand side. It is highly important in this as in all branches of art to begin slowly, marking in the distances and getting the relative position of the several objects exactly accurate. When you have drawn the outline, mark in the lines of the shadows.

A good scheme to save time and to secure breadth of tone is to make a small sketch—quite a rough one will do—of your subject and to mark out the lines of the shadows just as you do for your large drawing. Then number them according to the depth of tone in each. Thus when you have found the darkest mass of tone, you will number it 1. The next darkest will be 2. If there are more than one patch of the same darkness of tone, use the same number again; so that "2" will stand as a kind of label, indicating a particular depth of tone.

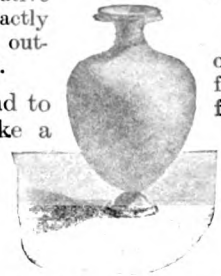

Fig. 57.—In the case of any egg-shaped body, the high light follows the line of the object's actual curve.

If you decide to make your drawing in this workmanlike and systematic manner, you will find it much easier than if you try to decide on the depth of tone of each separate shade or shadow as you come to it. Some people finish shading one object before they begin on the next. This is a great mistake; because however carefully you do this, the effect, in the end, is absolutely bound to be patchy. The next process will be to shade in turn each of those numbered parts; 1, then, we will say, two portions marked 2, then 3, then perhaps three or four marked 4—a lightish tone, this.

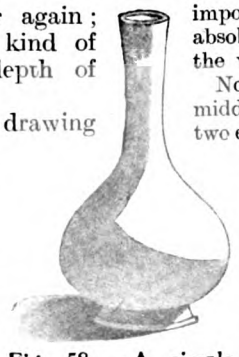

Fig. 58. — A simple study which lends itself to charcoal treatment.

A useful point to remember is that many common and everyday objects, such as you might choose to draw from, are in essentials based upon geometrical forms. Boxes, certain pieces of furniture, buildings, and books are based on the cube: the hexagonal prism is detected in pillars and some towers. Cups and logs of wood, to quote only two instances, are to all intents and purposes, cylinders.

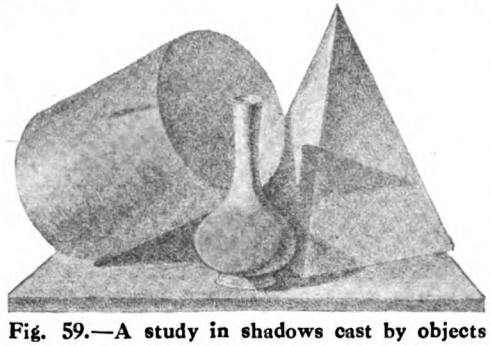

Fig. 59.—A study in shadows cast by objects one upon another.

It is highly necessary to practise shading from the *cast*, as you will be required to do so in most examinations which include the art of drawing.

In the first place, the cast should be on a level with the eyes, and about four feet away from you. The rays of light shall fall from above, and if you require light for the paper on which you are working (if, that is, you have no other light than that which illuminates the cast) it should come from the left.

An exceedingly useful example of this kind is provided by the Three Eggs, which is a well-recognised cast to draw from. When first doing this exercise hang the cast up on the wall, so that the effect you get is as though you were drawing the eggs from above. These are fixed to a base or slab which should be sketched first. It is extremely important to get the lines of this slab in absolutely true perspective, or you will make the whole drawing wrong.

Notice that a line which goes through the middle of the lowest egg *C* divides the bore into two equal parts (Fig. 60). Now draw a horizontal line which, so to speak, supports the other two eggs *A* and *B*. This passes over *C*, just touching its top; with a light touch of charcoal mark in the axes of the eggs. Draw the outline of the shades on the eggs and the shadows cast by them. Show by means of a round mark ○, where the high light comes in each case.

You should now put a tone on the background rather lighter than it actually seems to be to the eye. A method of doing this not previously mentioned is worth remembering. Rub a small quantity of your stumping chalk on a piece of wash-leather and use it on the drawing with great care. You will naturally try the leather first on some spare paper to make certain that the resulting tone is smooth and even.

This dodge is only to be used for the background, but the effect, if great care is taken, is admirable.

The shades may now be laid on each egg and you should try to keep to a level tone in all cases at present, of the same depth as the reflected light. You then work over your drawing gradually again, blocking in the shades to resemble those on the cast in a general way (Fig. 61).

To test the accuracy of your work is, in this case, easy and simple enough. Hang your drawing on the wall by the side of the cast and look at

the two and compare them from a distance of ten yards or so. In this way, you will see whether or not the broad masses of tone are relatively right, both in depth and of course in actual outline.

You can now continue working on your subject, darkening the edges of the shades towards the left and graduating the tone towards the reflected light. The gradation, which curves over the surface of each egg towards the high light should be especially light. All the surface covered by half-tone should be a good deal lighter even than that which catches the reflected light.

There is a great temptation (and one to which a large number of students persistently succumb) to make the reflected light too intense and brilliant. You will find by experiment, however, that the farther you step back from your drawing the darker the reflected light becomes, until you can hardly make it out. The half-tone, on the other hand, stands out with a perfectly distinct brightness.

Remember to get the edges of your cast shadows clean and sharp in the eggs and notice how they fall. The shadow from *A* partly falls on *B* and partly on *C*. Close to the outline of the eggs, the

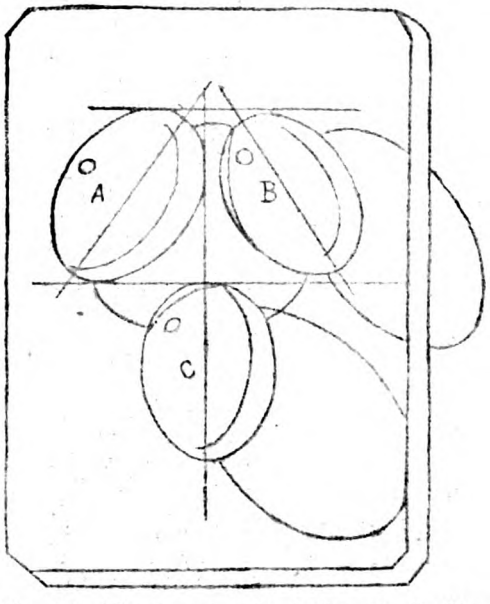

Fig. 60.—The first step in shading the familiar three eggs cast.

cast shadows in the background or base are very dark, graduating even to a much lighter tone. When practising this exercise, see that these points are right too.

Mr. W. E. Sparkes in his book, "How to Shade from Models," lays down six rules which epitomise the foregoing remarks in a succinct and easily memorised manner, which you will find useful to learn. These he heads as constituting a general method for shading casts.

(*i.*) *Sketch the outline of the eggs, their cast shadows and their shade.*

(*ii.*) *Lay on the background rather lighter than it appears.*

(*iii.*) *Shade the cast shadows of an even tint corresponding to the lightest portion of each.*

(*iv.*) *Add the deepest parts of the shades, and graduate them first towards the reflected light, and then towards the high light.*

(*v.*) *Deepen the cast shadows.*

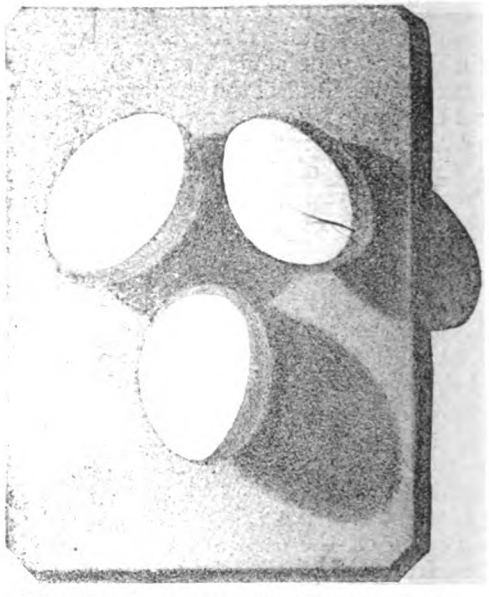

Fig. 61.—Three eggs—the finished sketch.

(*vi.*) *Add small graduated tints to the background where required.*

J. G. B. L.

OPINIONS

THERE are certain questions which can never be settled, and of these the question "What constitutes Beauty?" takes an important place. Take some well-known and popular picture. You say it is beautiful, everybody says that it is. But why? And—the most paramount point of all—are you perfectly certain that your opinion is an honest one? Are you prepared to analyse your feelings with regard to the picture in question and then swear that your opinion *is* your opinion and not the opinion of the majority, accepted by you without hesitation? That is taking a wide view of the subject. Let us now divide the topic into separate issues which are its natural outcome. Firstly then, there is the purely popular picture. This, we will say, was painted by a Royal Academician some thirty years ago, and it depends for its appeal upon the fact that it is literary: in other words, it tells a story. It is anecdotal. In this case the anecdote has an easily

emotional appeal. The scene depicted is of home life. The objects which compose the picture are all familiar objects, and the picture is given a name which explains where, probably, no explanation is required.

From the painting by Sir Joshua Reynolds.

"HEADS OF ANGELS"

which Ruskin thought was the greatest picture ever painted; "an incomparably finer thing than ever the Greeks did . . . . If you built a shrine for it and were allowed to see it only seven days in a year, it alone would teach you all of art that you ever needed to know." (Ruskin's *Queen of the Air*, ¶ 176.)

The untutored majority adore this picture because it presents in lively colour something that it knows and understands. There is no question of mental dishonesty here. People really do think it beautiful — people who do not look at the thing from the artist's standpoint, that is to say. Secondly, we have work which is fashionable. An artist suddenly acquires a vogue. Reproductions of his pictures are seen in expensive print shops and the originals are bought for large sums by collectors. You are confronted by one of this man's pictures. "Isn't it wonderful?" says some man who is by way of being fashionable. You say that

it is. Are you perfectly sure that the fact of its fashionableness has no weight at all with you ?

Let us turn to the third case. There is a small set of artists who admire and go in for a particular style of work. You, not being actually in that set, but knowing members of

OPINIONS MAY CHANGE.

Do you accept the Venus de Milo—height, 5 ft. 4 ins., waist, 26 ins., chest, 33 ins., hips, 38 ins., neck, 12½ ins., ankle, 7⅞ ins., arm, 22 ins. long, wrist, 6 ins.—as your idea of the woman physically perfect ?

it, are confronted with some of this work. It is not popular : it is not fashionable. Indeed it is loudly derided by the papers and the art critics and the older generation of artists. It may be futurism or post impressionism—what you will. Anyhow, only the set who produce it like it ; feeling friendly towards the protagonists of the new style, you express an opinion. Is that opinion your own ?

A sense of beauty is necessarily a personal thing, and it is more satisfactory to trust to one's own impressions than to reflect glibly some current opinion. On the other hand it is true that a feeling for beauty, just as a sense of music, can and ought to be cultivated. Unless people have been in the habit of seeing beautiful pictures or hearing pieces of good music, their judgment is hardly likely to be worth very much. Very often one finds those with an undeveloped taste being thrilled by the sentimental music of a Gounod or a Puccini when they would remain indifferent to the glories of a Bach or a Beethoven.

It is not sufficient to acquire cultivated tastes. They must, too, be informed, if a true appreciation of art is to be achieved. There have been, at different epochs and in different countries, schools of thought which held more or less definite ideals of beauty, of its purposes and its relation to life. Their works naturally cannot be understood unless the principles they held are known.

Greek Ideals

In these days, for instance, we very often admire a work of art because it is " so true to life.". Provided the expression is true and realistic, it satisfies the sense of beauty. This was, too, the view held by men of letters in France during the great and classic period in the latter half of the seventeenth century. " Rien n'est beau que le vrai," said Boileau in his *Art Poétique*, the traditions of which find consummate expression in the incomparable comedies of Molière.

Among the Greeks, however, this conception did not prevail. In Greek art, the expression of life was not realistic. It was subordinated to ideals of beauty. This is plainly evident in the great Statue of Laokoon who is represented with his two sons in a mortal struggle with fierce and deathly vipers ; yet the expression of the faces, the lines of the body, the relative position of the arms are not such as they would be in such awful circumstances in life. But the impression one gets is certainly one of great tragedy. Here Nature is subordinate to Art. The picture on page 497 by Sir Joshua Reynolds would assuredly have won the admiration of the Greeks. It is a masterpiece of pure beauty which can never fail to be a never-ending source of inspiration. Study in this connection, too, the reproduction of the Statue of Venus, found in the island of Milo in 1820. J. G. B. L.

Continued from page 440.

BUSINESS AND COMMERCE:

Contributors **:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).**

COMMERCIAL TRAINING.—XV

THE signed and stamped form from the Customs authorities, together with the bill of lading, constitutes the documentary demand for the actual delivery of imported goods from a ship.

When the goods are landed the consignee receives a Landing Account, which includes a full description and weight of the goods in question.

It may happen that the particular goods in the course of their journey have been damaged, possibly by sea water or other cause. In this case the Dock Company causes an inquiry to be made at the hands of experts, and the amount of the damage is decided upon. This inquiry is known as a Survey, and the document that explains the matter is termed a Certificate of Survey. It is issued by the Dock Company, and would be utilised by the consignee as the basis of his claim upon the underwriters when seeking compensation under the conditions of the Marine Insurance Policy.

Dock Samples

With a great many goods dock samples are taken during the process of landing by an official sampler, and these samples are, with the goods in question, accepted as being representative of the entire consignment.

What happens next necessarily depends upon the character of the goods, the nature of the trade, and such matters. With a great many classes of commerce, however, the consignee would hand over the goods to a produce broker for sale, and for the purposes of this sale the dock samples would very probably be handed on.

Produce brokers are business men who act as the go-between to merchants and buyers. In many trades these brokers hold sales at certain intervals—daily, weekly, monthly, and so on—and the dock samples are the basis of the transaction.

In the catalogue of the sale appear certain figures or numbers or marks which correspond exactly with those on the bales, cases or packages lying at the dock warehouses. And at the termination of the sale the purchaser finds that for his money he possesses a Warrant, a document bearing a 3d. stamp, and that by presentation of this Warrant to the Warehouse-keeper or to the Dock Company he will receive the goods he has bought in exchange.

Shipping Agents

The question of payment for a consignment from abroad, so far as the carriage is concerned, is purely a matter of arrangement, and is dependent upon the custom of the particular trade. In many instances goods are dispatched " C.I.F.," which means that the price paid includes Cost, Insurance, and Freight to the port of destination. The reverse of this is " F.O.B.," meaning Free on Board. In this case the quotation, or order given, merely includes the cost of the goods, and does not embrace the fee for insurance or the charges for carriage.

When the produce broker has disposed of goods and handed the warrants to the customers from whom he has received his money, his next step is to make a full return of the transaction to the merchant or importer of the goods. In this return he shows in full detail particulars of the cash amounts realised by the different items sold, the expenses incurred in the sale, if any, and his own percentage or commission on the transaction.

This varies considerably with the different trades.

Generally speaking, the bulk of the business in export goods is done through merchant shippers, shipping agents, and such firms whose commercial mission is not concerned with production, but only with the receipt of orders and the dispatch of goods.

In the ordinary course of events there are

three classes of commerce that may be exported from this country :

(1) Goods produced entirely at home.
(2) Goods produced abroad and imported for the sole purpose of being re-exported.
(3) Goods obtained from abroad and warehoused in bond.

Duties do not apply to exports as they do to imports broadly, though a tax is imposed on exported coal. At the same time, the Customs officials are quite as interested in a ship clearing outwards as in an incoming vessel, largely from the point of view of vital national statistics and their compilation.

We will assume that a shipping merchant in London receives from abroad orders for certain articles. This order is referred to as an Indent, and it specifies precisely the goods required and the quantities, how they are to be marked and numbered, how and by whom the merchant is to be paid, and the method of forwarding. The question of insurance will also be covered.

Shipping Goods

Briefly, the work that follows is the purchasing of the goods from the manufacturer, broker or other vendor, and the dispatch of them by the most expeditious and convenient means.

The various shipping lists at hand will acquaint the merchant with details of the next steamer leaving for the particular destination, where she will be berthed, and the date of sailing. He has also to find out the latest time up to which goods may be accepted, and it is a rule of shipping routine that all cargo shall be delivered at the earliest possible moment in order to facilitate stowing and packing.

All this information will be collated and given to the manufacturer with the order for the goods. In addition, details will be given as to how the goods are to be marked, for a consignment of mixed merchandise is not addressed like so many postcards, but is identified by the initials of the firm and a system of signs or symbols, followed by numbers, and the name of the port of arrival.

In the meantime, whether the goods are to the order of the merchant shipper, an agent or broker, or the manufacturer himself, the steamship owners must be notified and bills of lading be prepared. It is clear, therefore, that exporting or importing goods is not a simple business. It is a task requiring careful and efficient organisation.

A. B.

CHOOSING A CAREER.—XVI

Municipal Services (*Concluded*).—Junior clerks in the treasurer's department of a council need to acquire a thorough working knowledge of arithmetic, algebra and kindred subjects ; whilst book-keeping is of the first importance.

A knowledge of statistics, abstracts, loans and stock, cheques, banking and all such matters is vitally essential and the junior of three years' service may enter for the primary examination of the Institute of Municipal Treasurers and Accountants (Incorporated) and afterwards the final examination. Regulations of these examinations and a list of books recommended for study together with a syllabus may be obtained (Price 1s.) from *Mr. P. Farnworth, F.S.A.A., Honorary Secretary of the Examinations Committee, Borough Treasurer of Bolton, Lancs.*

After ten years' service the examination of the Society of Incorporated Accountants and Auditors may be taken ; and certificates from either of these two bodies will go a long way towards ensuring rapid promotion.

In each of the departments there are opportunities for the junior to cultivate a technical and practical knowledge of the duties of that department over and beyond the more or less trivial tasks that come his way from day to day. The waterworks clerk, for instance, may visit the reservoirs in his spare time and acquire some knowledge of the actual work of that department ; and it is the junior who digs deeply into the practical side of things and who allows his keen interest to lead him to the point of a personal investigation who will eventually succeed.

And, generally speaking, throughout the councils of the kingdom, official encouragement is given to the junior who makes it plain that he has taken up the Local Government work as a serious career. In some cases leave of absence is granted to juniors who are seeking to qualify for examinations, and there are instances in which a youthful worker is financially assisted where heavy fees have to be paid for acquiring professional qualification.

With some councils, and more particularly in the metropolis, clerks are divided into classes : the Junior Grade, Third-Class Grade, Second-Class Grade, and First-Class Grade. Salaries run from £50 a year in the lowest class to £400 in the highest. Generally, in the London boroughs, heads of departments receive from £500 to £800 a year and even more.

So far as pensions are concerned, the provisions vary considerably and an effort is being made to bring all Local Government officers under one scheme of superannuation. At present, there are some councils that provide no pensions at all; but with some of the municipalities there is a scheme under which officers may retire at the ages of 60 or 65, or in consequence of permanent illness after 10 years' service, with a fixed superannuation.

Usually, a sum varying from 2 to 3½ per cent. is deducted from the salary of the officer under this system. Then, when the period for his retirement comes, his salary for the previous five years is averaged and a proportion of this amount is granted for every completed year of service.

In the same way, an effort is being made to standardise an entrance examination for junior clerks. Some of the councils have no examination at all; whilst others specify a definite test. Others, again, accept the certificate of proficiency granted by the National Association of Local Government Officers as proof that the candidate is educationally suitable.

This certificate is to be obtained by passing an examination in grammar and composition; English history, arithmetic, algebra, geography, Euclid and a choice of other subjects; the type of examination that could be passed by a boy of average secondary school education.

The examinations conducted by the following bodies also enter into the various schemes of municipal employment, according to the particular department in question:—

The Institute of Civil Engineers.
The Surveyors' Institution.
The Institute of Chartered Accountants.
The Society of Accountants and Auditors.
The Chartered Institute of Secretaries.
The Law Society.
The Royal College of Surgeons.
The Royal College of Physicians.

Candidates who have passed the preliminary examinations of any of these societies may in certain circumstances receive appointments and qualify for the intermediate or final examinations of their respective institutions whilst they are actually holding position as junior officers.

And, in all the departments, apart from the purely technical and professional knowledge required, it is essential that the officer shall clearly understand the law as it applies to the particular branch of municipal work affecting his own routine.

In some instances the police force so far as its maintenance is concerned comes under the local council or corporation; whilst even the building of post offices is not beyond the scope of the local authority.

So far as the employment of women goes, an outlet is found for their energies more in the direction of carrying out the Public Health Acts; and there are **Women Sanitary Inspectors, Medical Officers of Health, District Health Visitors** and so on; whilst many of the municipal libraries are staffed entirely by girls and women.

There is no royal road to success in any calling or career; but the general opinion among municipal officers is that a lad commencing in the provinces has greater opportunities of attaining to high position than one starting in the metropolis. In London local control is so subdivided between the councils, the Metropolitan Water Board, the Metropolitan Asylums Board, the various gas companies, the county system of trams both for London and Middlesex, and other bodies, that the young worker has no opportunity of reviewing Local Government work from every aspect.

In the country, however, the beginner is more or less in close touch with every phase of municipal activity and in consequence faces a wider field with proportionately greater opportunities.

Generally speaking, by custom, and with most of the higher appointments by law, vacancies are notified to the general public by means of advertisement. Most of these advertisements appear in local newspapers, in professional papers when the vacancy calls for a professional man, and in many cases in the *Municipal Journal*.

Usually blank application forms are supplied and some of the advertisements intimate the number of councillors concerned; so that the applicant may supply the number of copies of testimonials that each member of the council may receive one. The canvassing of councillors by a candidate is of course prohibited.

In the case of the lesser positions, those of junior clerk, for instance, there are no set rules and the would-be candidate should address a letter to the local town clerk upon the matter. *Mr. L. Hill, General Secretary National Association of Local Government Officers, Caxton Hall, Westminster, S.W.*1., may also be consulted by candidates as to the best course they can take. A. C. M.

BILLS RECEIVABLE BOOK

No. of Bill	Date Received.	From whom Received.	Ledger Folio.	Discount.	Amount of Bill.	Drawer.	Acceptor.	Where payable.	Date of Bill.	Term.	Due date.												Remarks.
											Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	

BILLS PAYABLE BOOK

No. of Bill.	Date Accepted.	To whom given.	Ledger Folio.	Discount.	Amount of Bill.	Drawer.	To whom payable.	Where payable.	Date of Bill.	Term.	Due date.												Remarks.
											Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	

BOOK-KEEPING.—XI

CASES arise in actual business where for some reason the Drawee of a Bill refuses or neglects to accept the draft as drawn, or having accepted the bill fails to meet it when it becomes due for payment. This refusal to accept or pay the bill is known as dishonouring the bill, and it now becomes necessary to show how dishonoured bills are treated in the books of account.

Treatment of Dishonoured Bills

One effect of the dishonouring of a bill is that the parties to it revert to their former position as regards liability. It is necessary that immediate notice of dishonour should be given to the Drawer, and also to the Endorsers (if any) in order to meet the requirements of the Bills of Exchange Act.

It may sometimes be deemed desirable to have a bill noted after dishonour, although this is not legally necessary in the case of an inland bill. **Noting** is, however, essential when a foreign bill is dishonoured. Noting consists of the bill being presented either to the Drawee or to his paying bank by a Notary Public. In addition to noting he will, if the bill is a foreign one, prepare a **Protest,** that is, a statement containing particulars of the bill and the fact of dishonour, and indicating the replies he has received to his inquiries.

When a bill is dishonoured, the measure of damages is usually reckoned as follows :—

1. The actual amount of the bill.
2. Interest from the time of presentment, if the bill is payable on demand, or from the date of maturity in other cases.
3. Expenses of noting.

The measure of damages in the case of a foreign bill would include :—

1. Re-exchange, i.e. the loss resulting from the dishonour of a bill in a different country. This is ascertained by calculating the sum at sight which would be equivalent to the dishonoured bill plus expenses of protest, postage, commission, etc.
2. Interest on the above.

The treatment of dishonoured bills in the books of account will depend entirely upon the previous history of the bill. Supposing you hold James Dennis's acceptance for £350. On the due date it is presented by you for payment at his business house or bank, and is dishonoured. In order that you may have tangible proof of dishonour you have the bill presented by a Notary Public, whose fee, 5s., is paid by you.

A Journal entry will be made to record the transaction in your books. James Dennis will be debited with the amount of the bill ; the Bills Receivable Account will be credited ; as that which was a Bill Receivable no longer represents anything of value, having in effect ceased to exist.

Dis.	*Cash.*	*Bank.*		*Dis.*	*Cash.*		*Bank.*
					s.	*d.*	
			By James Dennis (Noting charges)		5	–	

The Journal entry will be as follows :—

		£	*s.*	*d.*	£	*s.*	*d.*
James Dennis	Dr.	350	–	–			
To bills receivable					350	–	–

Noting Charges

James Dennis must also be made responsible for payment of the noting charges of 5s. This being a payment out of your cash, the record will appear in the Cash Book as if it were a payment made to James Dennis. It is, in fact, paid on his behalf.

If the above bill had been discounted by you with the bank, the latter would notify you of the dishonour, and at the same time return the bill. In that case it would be necessary to credit the bank, and debit the account of James Dennis.

If the bank merely returned the bill dishonoured, and you decided to have it represented by a Notary Public, it would be necessary for you to pay his fee. Such payment would be recorded in the Cash Book, cash being credited as shown above.

Take another case, an acceptance for £250

has been received by you from William Simpson. You pass on this bill to Samuel McNeill in part payment of an account owing by you to him.

Immediately after the due date, you receive notice from McNeill that the bill has been dishonoured, and that he has paid 4s. as Noting Charges. It is obvious that McNeill, whose claim you thought you had satisfied, will again become your creditor, and that Simpson, from whom you received the acceptance, must be debited with the value of the bill, and in addition the 4s. Noting Charges. The Journal entry which will adjust the matter will be as follows :—

		£	s.	d.	£	s.	d.
W. Simpson	Dr.	250	4	–			
To Samuel McNeill					250	4	–
For dishonoured bill and noting charges.							

From the example given it will be seen that when a bill is dishonoured, the entries to be made in the books are such as will restore matters to the position in which they stood before the bill transaction took place.

Renewal of a Bill

The word Renewal when used in connection with bills is somewhat misleading. To renew a bill is in fact to cancel it, and to substitute a new bill in its place. The renewing of a bill may be desired for various reasons, e.g. it is possible that the acceptor may, at the time when the bill falls due, find himself short of funds. He will approach the drawer with a request that the bill may be renewed for a definite period, it being understood that he is willing to pay interest for the desired extension of credit.

When making the necessary entries in the books to record the renewal of a bill, three things require to be borne in mind, firstly, the old bill has to be cancelled, secondly, the interest charged has to be shown, and thirdly, the new bill has to appear.

Suppose that William Wilberforce agrees to renew my acceptance for £120 for a further three months, and that it is arranged that I shall pay £2 by way of interest for this concession. The three Journal entries will be as follows :—

(1)		£	s.	d.	£	s.	d.
Bill Payable	Dr.	120	–	–			
To William Wilberforce					120	–	–
(2)		£	s.	d.	£	s.	d.
Interest	Dr.	2	–	–			
To William Wilberforce					2	–	–
(3)		£	s.	d.	£	s.	d.
William Wilberforce	Dr.	122	–	–			
To Bill Payable					122	–	–

These entries will, of course, be posted to the appropriate Ledger accounts.

The above entries show the procedure followed in the case of a Bill Payable. When a Bill Receivable is renewed, precisely the same records are necessary. Suppose that Thomas Boyter requests me to renew his acceptance of £130 for a further period of two months, and that the charge for interest is £1 10s. 0d., the Journal entries will be as follows, viz. :

(1)		£	s.	d.	£	s.	d.
Thomas Boyter	Dr.	130	–	–			
To Bill Receivable					130	–	–
(2)		£	s.	d.	£	s.	d.
Thomas Boyter	Dr.	1	10	–			
To Interest					1	10	–
(3)		£	s.	d.	£	s.	d.
Bill Receivable	Dr.	131	10	–			
To Thomas Boyter					131	10	–

It may happen that although the acceptor is not in a position to pay the full amount of a bill, he is able to pay part of the amount. The sum paid will be entered in the Cash Book, and credited to his account. In addition it will be necessary to make three Journal entries similar to those shown above.

On page 502 will be found specimen rulings of a Bills Receivable and Bills Payable Book, from which it will be seen that they are so arranged as to give at a glance all the necessary information regarding Bills Receivable or Bills Payable. The information is tabulated in parallel columns with, in most cases, single vertical rulings. The first four columns give the number of the bill, the date received and from whom it was received, and the ledger folio. A double vertical ruling follows, for the amount of the bill, etc.

Definitions of Terms

Pro-forma Invoice.—This is a document made out in the form of an invoice for form's sake only. It does not represent an actual transaction, its object being not to make a charge, but merely to give information.

Promissory Note (P/N).—This is an unconditional promise in writing, signed by the maker, agreeing to pay to a specified person or order of bearer, a certain sum of money at a fixed or determinable future time.

An Accommodation Bill is one for which no value has been given, but which has been issued with a view to raising money, and thus accommodating one or both parties of the bill.

To retire a Bill is to pay it before the due date.

F. H.

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